INDIAN VETERINARY RESEARCH INSTITUTE

DIAMOND JUBILEE 1890—1950

INDIAN FARMING—SPECIAL NUMBER

KZ:f2,M90
N51
125301

...d by The Indian Council of Agricultural Research

PUBLICATIONS COMMITTEE

SARDAR DATAR SINGH, F.R.S.A., *Vice-President, Indian Council of Agricultural Research.*

R. L. SETHI, I.A.S., *Agricultural Commissioner with the Government of India.*

P. N. NANDA, M.R.C.V.S., *Animal Husbandry Commissioner with the Government of India.*

B. P. PAL, M.SC., PH.D., F.L.S., *Director, Indian Agricultural Research Institute, New Delhi.*

S. DATTA, D.SC., M.R.C.V.S., D.T.V.M., F.R.S, (Edin.), F.N.I., *Director, Indian Veterinary Research Institute, Mukteswar.*

Z. R. KOTHAVALLA, B.AG., D.SC., N.D.D., *Director, Indian Dairy Research Institute, Bangalore.*

S. B. SINGH, M.SC., PH.D. (Cantab.) *Director of Agriculture, Uttar Pradesh, Lucknow.*

H. B. SHAHI, M.SC., M.R.C.V.S., D.T.V.M., *Director of Veterinary Services, Madhya Pradesh, Nagpur.*

P. PARIJA, D.SC., *Pro-Vice Chancellor, Banaras Hindu University, Banaras.*

HEM SINGH PRUTHI, M.SC., PH.D., SC.D. (Cantab.), F.R.A.S.B., F.N.I., *Plant Protection Adviser to the Government of India.*

B. N. CHOPRA, D.SC., F.N.I., *Fisheries Development Adviser to the Government of India.*

A. R. VYAS, *Director of Publicity, Ministry of Food and Agriculture, Government of India.*

S. R. MAINI, I.A.S., *Secretary, Indian Council of Agricultural Research.*

U. N. CHATTERJEE, D. PHIL., D.SC., F.N.A.SC., *Editor, Indian Council of Agricultural Research.*

EDITORIAL BOARD

SARDAR DATAR SINGH, F.R.S.A., *Vice-President, Indian Council of Agricultural Research.*

R. L. SETHI, I.A.S., *Agricultural Commissioner with the Government of India.*

A. R. VYAS, *Director of Publicity, Ministry of Food and Agriculture, Government of India.*

S. R. MAINI, I.A.S., *Secretary, Indian Council of Agricultural Research.*

P. N. NANDA, M.R.C.V.S., *Animal Husbandry Commissioner with the Government of India.*

Editor

U. N. CHATTERJEE, D.PHIL., D.SC., F.N.A.SC.

Annual Subscription*: Rs. 6. Per issue: 8 as.

To
THE MANAGER OF PUBLICATIONS,
CIVIL LINES, DELHI.

Indian Farming Subscription Order

Please send the monthly magazine *Indian Farming* to the following address on publication. I enclose a Postal Order/Money Order receipt for Rs. 6 in payment of the subscription for one year.

Name....................................

Address..................................

....

....

541

INDIAN VETERINARY RESEARCH INSTITUTE

DIAMOND JUBILEE 1890–1950

INDIAN FARMING—SPECIAL NUMBER

सत्यमेव जयते

THIS NUMBER REPLACES THE MARCH, 1951 ISSUE

Issued by The Indian Council of Agricultural Research, India

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE ASHOKA PRESS, DELHI GATE, DELHI

ICAR—21.3/51 (Spl.)
3,600

XXV.B 43

125301
234/1951
XXVA 60-2

CONTENTS

PAGE

MESSAGE FROM THE PRESIDENT . . . . . . (iii)

MESSAGE FROM THE HON'BLE SHRI K. M. MUNSHI, MINISTER FOR FOOD AND AGRICULTURE . . . . (v)

THE PROBLEM OF LIVESTOCK DEVELOPMENT IN INDIA . *P. N. Nanda* 1

INDIAN VETERINARY RESEARCH INSTITUTE, 1890-1950 . *S. Datta* 6

PATHOLOGY AND BACTERIOLOGY SECTION . . *M. R. Dhanda* 19

BIOLOGICAL PRODUCTS SECTION . . . . *Balwant Singh* 24

PARASITOLOGY SECTION . . . . . *H. N. Ray* 28

ANIMAL NUTRITION RESEARCH SECTION . . . *N. D. Kehar* 35

POULTRY RESEARCH SECTION . . . . *S. G. Iyer* 41

ANIMAL GENETICS SECTION . . . . *P. Bhattacharya* 45

TRAINING FACILITIES . . . . *S. Datta* 51

GENERAL ORGANIZATION AND ADMINISTRATION . *B. R. Ramchandani* 58

THE INSTITUTE STAFF 62

KZ: f2, M90
N51

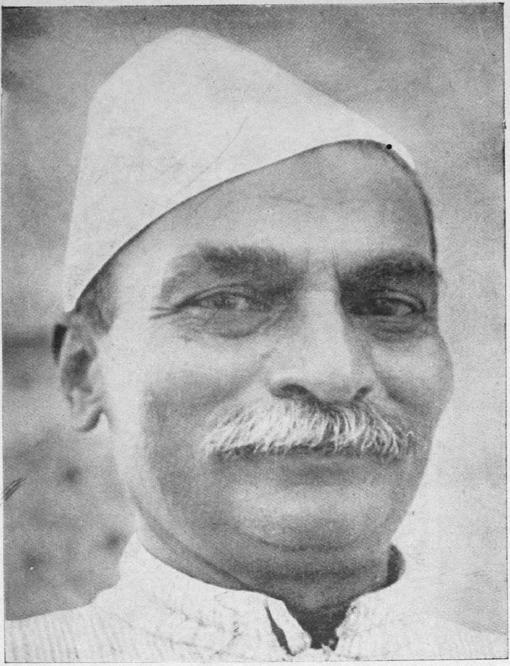
Any article or illustration in the magazine may be reproduced or translated in any registered newspaper or periodical without special permission, provided the source is acknowledged in each case. A copy of the newspaper or periodical containing the article or illustration should be sent to the Editor.

The Indian Council of Agricultural Research does not accept responsibility for opinions or statements contained in contributed articles or in advertisements in this magazine.

Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London WC 2.



The President

सत्यमेव जयते

GOVERNMENT HOUSE,
NEW DELHI
24th Feb, 1957.

It is a matter of satisfaction to learn that the Indian Veterinary Research Institute is celebrating its Diamond Jubilee on the completion of 60 years of its useful existence. It has done good work and I hope that it will not only continue to maintain the standard of work it has been doing but would also improve upon it. It has my good wishes for its successful working in the future.

Rajendra Prasad

PRESIDENT.

The Hon'ble Shri K. M. Munshi, Minister for Food and Agriculture

MINISTER FOR AGRICULTURE
GOVERNMENT OF INDIA

1, Queen Victoria Road,
NEW DELHI,
26th February 1951.

The Indian Veterinary Research Institute celebrates its Diamond Jubilee in the month of March. From a humble beginning in 1890 it has grown into a full-fledged research organisation in all the major aspects of veterinary science. It has rendered valuable service to the cause of livestock in this country. If it has been possible in a substantial measure to control that fell disease, rinderpest of cattle, the credit goes to the Institute. Similarly, in the conquest of Ranikhet disease of poultry, in the prevention and cure of surra in cattle and horses, in initiating investigation on substitute feeds, and in various other fields of veterinary research the contribution of the Institute has indeed been commendable. Of special importance in improving farm animals, especially cattle, is the Institute's work in connection with artificial insemination. I fervently hope that the Institute will have an even brighter future.

(K.M. Munshi)

INDIAN VETERINARY RESEARCH INSTITUTE

DIAMOND JUBILEE 1890—1950

INDIAN FARMING — SPECIAL NUMBER

THE PROBLEM OF LIVESTOCK DEVELOPMENT IN INDIA

By P. N. NANDA

FROM references in the Parliament, in the public press and on the public platform, there appears to be a general lack of understanding or appreciation of the problem of animal husbandry development in India. What one is led to infer from such references is that the general public have a vague idea that it is important to develop the cattle of the country, but there is no clear perception of the magnitude of the livestock industry or of the complex nature of the problem of its development. It is not generally realized that livestock development is a big problem of very great economic importance and that its solution should be sought not by isolated efforts but through a long range comprehensive plan on a wide scale, commensurate with the magnitude of the industry and with full provision for meeting the special environmental conditions under which livestock are reared in India. In this article which is being written on the occasion of the Diamond Jubilee of the Indian Veterinary Research Institute, it is proposed to give an account of the magnitude and importance of the problem and to describe the role which the Institute has to play in its solution.

P. N. NANDA is Animal Husbandry Commissioner with the Government of India.

Nature of the problem in India

Development of animal husbandry in India envisages improvement by breeding, feeding, disease control and management of the large livestock population which for various reasons is in a very undeveloped state. In point of numbers, India possesses more animals per head of human population and per acre of cultivated land than most other countries of the world do. She owns about 136 million head of cattle and 40 million buffaloes which constitute about a quarter of the world's total bovine population, in addition to 37 million sheep, 46 million goats and 3 million other animals like horses, mules and donkeys, not to speak of millions of poultry. Even judged by numbers alone, the problem is a colossal one and it is further complicated by the peculiar nature of the environmental conditions in which livestock are reared in India. Apart from the wide variety of climates and soils, the average breeder is a poor peasant owning only one or two animals and is generally illiterate and poor. These conditions are entirely different from those obtaining in other livestock countries of the world, and as has been said by Duckham in his review of the Animal Industry in the British Empire, India is an exception to every accepted generalization in this regard. This is what makes for complexity and it is essential that in the solution of this

problem, we should not only have the technical talent, required for dealing with animal husbandry but also the talent for organization of a very high order.

Magnitude of the industry

It may be of interest to examine the magnitude of the industry even in its present undeveloped state. It has been estimated that the annual contribution of Indian livestock to the Indian economy is of the order of Rs. 4,000 crores when prices are reckoned at those ruling at present. Apart from this huge aggregate value of cattle labour and of the production of milk, milk-products, wool, eggs and meat, most of which are used or consumed at the source of production, the internal and external trade in livestock and livestock products is of considerable magnitude. India is the largest supplier of hides and skins to the world market and produces some of the best carpet wools in the world which are mainly exported. Figures of internal trade are lean but every year about 1,021 cattle fairs are held in India, wherein approximately on an average 11,000 animals per fair are assembled. About 272,000 head of cattle, 2 to 5 million maunds of bones, 3 million maunds of raw hides and skins, 600,000 maunds of tanned hides and more than 700,000 maunds of *ghee* are carried annually by rail and river among the different States of India. No figures are available for the trade passing through roads, which also is known to be considerable.

Cattle development

Cattle form the most important part of the livestock industry in India. Work so far done on their development has indicated that the present low level of production is not due to any intrinsic inability to produce but because of the lack of necessary environmental conditions for their successful exploitation. It has been found that the Indian cattle do possess potentialities of a high order and they respond favourably to better conditions of breeding, feeding, disease control and management. Provision of such better conditions is the greatest problem.

The first essential is the provision of a sufficiently large number of high class breeding bulls. At present the number of bulls available in India falls far short of the actual requirements—the actual number being 1 where 250 are required. There are large tracts in the country where cattle have degenerated into puny little beasts which are quite unproductive and uneconomic to maintain. Even if such animals are graded up with bulls of well defined breeds, the problem of rearing the progeny under existing adverse environmental and feeding conditions is a problem which has so far baffled the workers. What will induce the cultivators in such areas to adopt better animal husbandry practices for graded animals still remains one of the many unsolved problems. Secondly, in the matter of feeding there is a considerable shortage. The feeds at present available can maintain only about half of the existing livestock population. The possibility of utilizing the monsoon grasses in forest areas which at present largely go waste has been under investigation for some time past, but no workable solution as regards their economic preservation and transport to the areas of consumption has so far been evolved. Similarly, several emergency fodders which could be used to make up the fodder deficiency have been evolved at the Indian Veterinary Research Institute, but again, their economic utilization presents a problem. In regard to diseases also, the position is far from being satisfactory. There is little cooperation coming forth from the cultivators who often oppose the adoption of prophylactic measures and usually agree to the control measures being taken only in the face of actual outbreaks of diseases. Deaths from contagious diseases take a toll of *about three lakh* lives annually, in addition to the decreas-

ed efficiency of production caused in the survivors. The main problem thus reduces itself to one of meeting the deficiencies in these directions as from other factors like marketing, etc. which also have a direct bearing on the development of the industry.

The complexity of the problem is further enhanced in view of the fact that each of these items, i.e. breeding, feeding and disease control is a specialized branch of science and a fast developing science. There are various matters in regard to all these which require original investigation, or in regard to which the results obtained in other countries have to be tested under the conditions obtaining in India. The knowledge which at present exists is obtained from the work done in temperate climates, and there are various matters, as was revealed at the Conference recently held by the F.A.O. of the United Nations, which are common to tropical countries and which require investigation. A number of recommendations were adopted by the Conference for studying these matters under conditions obtaining in the tropics. India, as the largest livestock country in the tropics, has a special responsibility in the matter, not only in regard to the development of vast potentialities of her livestock but also in regard to the common good of other countries situated in the tropics. Under the directive principles of State Policy (Part IV—Section 48, p.21) embodied in our Constitution, it has been laid down that:

> 'The State shall endeavour to organize Agriculture and Animal Husbandry on modern scientific lines and shall, in particular, take steps for preserving and improving the breeds and prohibiting the slaughter of cows, calves and other milch and draught cattle'.

Organization

An apparently comprehensive organization exists in India for dealing with the problem of livestock development but the subject is the primary responsibility of the States (vide item 15 of Seventh Schedule, State List), Centre being concerned only with the coordination of the local activities and the provision of guidance in regard to research and development. The organizations in the States consist of an Animal Husbandry Department which is responsible for the development of all animal husbandry activities. These departments have also livestock farms where in addition to research on breeding and development, demonstrations are held for convincing the villagers about the usefulness of modern scientific methods of breeding, feeding and disease control. The farms established by these Governments distribute superior bulls in the village areas. The Departments also arrange cattle shows in which propaganda for encouraging the development of pure strains is carried on and prizes are awarded to the owners of best exhibits. The central Government have institutes of their own for carrying on research on fundamental problems. The Indian Veterinary Research Institute is the largest organization for purposes of conducting research on diseases, nutrition, artificial insemination, poultry and cognate matters. The Indian Dairy Research Institute at Bangalore deals with all matters connected with dairying. The Indian Council of Agricultural Research is the coordinating organization for the work of the central as well as of the provincial organizations through its Research and Extension Boards which have been recently set up.

It has been found that though apparently the existing organization is quite comprehensive, it is not large enough for dealing with a quarter of the world's cattle population. It has also been found that the demonstrations held on the Government farms and the propaganda carried on by the departmental officers do not bear full fruit because of the large differences in the conditions obtaining in

the villages and on the Government farms. The villager who is poor and resourceless is not able to provide on his holdings those conditions which the Government are able to provide on their farms or institutions. It is, therefore, increasingly realized that in order that the demonstrations and the propaganda may benefit the villagers fully, it is essential that the research activities of the Government are conducted in the villages under the conditions obtaining there. The villagers will then be able to utilize the results of research when the success of the methods adopted by Government is fully brought home to them.

Key Village Plan

As a result of this realization, a Key Village Plan has been drawn up by the Indian Council of Agricultural Research. This plan envisages the establishment of a network of key villages all over India. The most important feature of this plan is that it introduces a system and a plan into the present methods of distribution of bulls according to which, the areas where the improved bulls are distributed, no other bull will be allowed to work. The key village has been defined as a compact area consisting of one village or a group of contiguous villages containing a total adult cow population of 500. This area will initially be surveyed in order to ascertain the distribution of cattle, and various other matters like the productive capacity of the animals, the present arrangements for the production and distribution of milk, the resources in feeding materials and so on. All the bulls available in these areas, if not found upto the standard, will be removed or castrated and replaced by the necessary number of approved bulls. The first stage of this work is only the establishment of the key villages with a view to ensuring that only approved bulls serve in the areas. In the first stage a periodical recording of milk will also be done in order to send out what improvement has been brought about in the milk production. When this stage is completed, it is proposed to go a step further and to introduce all the measures necessary for the improvement of cattle, like the absolute control of breeding, marking of animals and their progeny for identification, recording of milk production and other cognate matters. By the end of the third stage, these key villages are expected to work as though they were Government cattle breeding farms. It is hoped, by then, that the breeders in the key villages will be combined into cooperative bodies which would carry on the work under a system of subsidy and supervision by the Government so that these bodies may be able to look after all matters connected with breeding, feeding and disease control as well as the marketing of the livestock and livestock products. In view of the extreme shortage of approved bulls in the country, the feasibility of introducing artificial insemination in the key village centres has been taken up and a pilot scheme has commenced working in the ten villages selected near Delhi for development work under a scheme sponsored by the Indian Council of Agricultural Research.

The Indian Veterinary Research Institute

The Indian Veterinary Research Institute is the only central Institute of its kind in the country and some of its main functions are:

(a) Fundamental research in regard to various contagious diseases and pests in India
(b) The production of biological products for the prevention and cure of diseases
(c) Fundamental research in animal nutrition
(d) Breeding and improvement of poultry
(e) Fundamental research in animal genetics and artificial insemination
(f) Post-graduate training courses

As to the nature of activities in the various branches of this Institute, it may be briefly stated that the causative agents of most of the common diseases of animals in this country have been established and suitable methods to control them have been evolved. The institute is issuing annually ten million doses of different biological products for use in the fields. In order to reduce the deficiency in feeds and fodders, considerable amount of work has been done in the Nutrition Section on the utilization of various industrial by-products and other waste materials. Mainly, as a result of progress made in the Animal Genetics Section the adoption of artificial insemination on a field-scale is now being increasingly taken up by the various States. The Poultry Section of the Institute has evolved an indigenous strain of poultry which compares very favourably with some of the foreign breeds as regards egg production. Considerable headway has also been made in poultry technology. To meet the increasing demand for highly trained technical personnel, post-graduate courses are available in the various branches and these are being fully availed of. All this would indicate what an important role the Indian Veterinary Research Institute is playing in the solution of the various problems facing the country in the development of its livestock. It is also evident that if the Institute is to continue to bear the full burden of its responsibilities, no stone should be left unturned in the matter of its development and expansion.

INDIAN VETERINARY RESEARCH INSTITUTE, 1890–1950

By S. DATTA

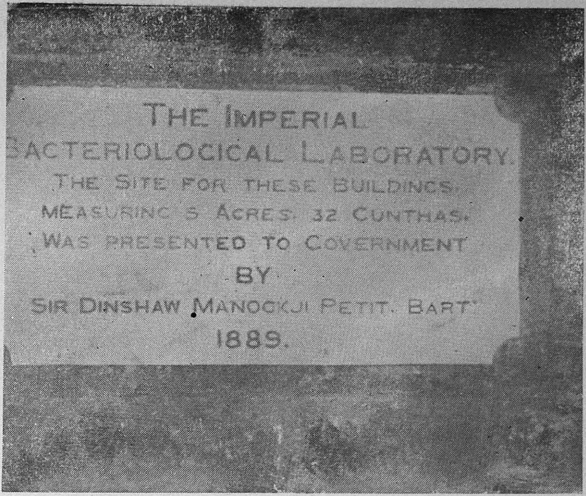
ORGANIZED scientific research on modern lines into the problems of livestock conservation and development in India, may be said to have started in 1890 with the establishment of what is now known as the Indian Veterinary Research Institute. The foundation stone was laid by the Governor of Bombay on 9 December, 1889, at Poona, on 5½ acres of land adjoining the College of Science, which was presented for the purpose by a Parsi philanthropist, Sir Dinshaw Manockji Petit, Bart. Scientific activity in India in some pure and applied branches had already commenced. However, reference must naturally be restricted to such activity as relates directly to the veterinary science which was deemed so important as to induce the Government of India to establish the Indian Veterinary Research Institute or its forerunner, the Imperial Bacteriological Laboratory, and this happened to be the very first scientific research institute to come into being in India and probably in the East.

Cattle plagues had been so poignant and sudden in their devastating effects on the animal population and in paralysing agricultural and ultimately the food position, that most ancient people all over the world were simply terror-stricken by them and felt utterly helpless. They used to consider these outbreaks as supernatural visitations meted out by Divine wrath. With the advent of scientific approach, veterinary colleges and organized veterinary services were brought into being to protect the agricultural economy and to ensure a steady food production by the control and prevention of the ravages of these plagues which were decimating the domestic livestock.

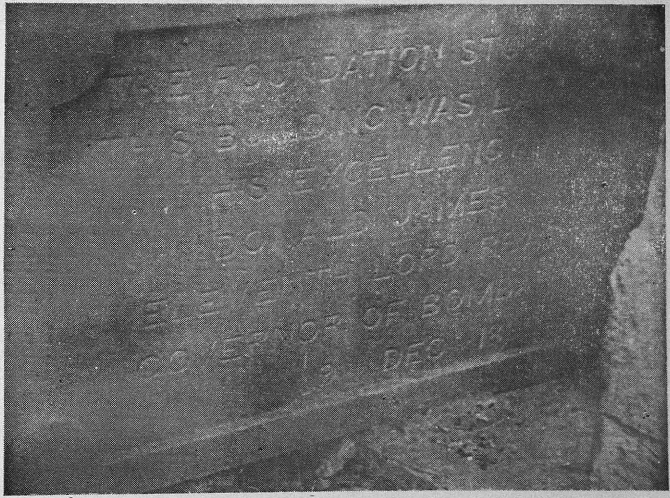
S. DATTA is Director, Indian Veterinary Research Institute, Mukteswar and Izatnagar.

Advent of veterinary work in India

In India, animals, particularly the cow, had received considerable attention, appropriate to those days, in the Vedas and Puranas, and veneration for the cow has been handed down through centuries. It seems certain that the importance of livestock in human welfare was appreciated even during the earliest days of Indian history. In the British era, men to look after stud farms were being imported by the John Company since 1774. In the days of the East India Company, Europeans and Anglo-Indians were employed to serve the needs of the Army. Disease was rampant and breeding operations were generally unsuccessful. These early men were mostly unqualified. William Moorcroft was the first Member of the Royal College of Veterinary Surgeons to come to India in 1808 and the Army Veterinary Department seems to have started functioning since 1827. The men who followed devoted attention to the study of some of the tropical diseases encountered in the army horses, and an appreciable amount of early literature resulted. Nothing, however, of importance appears to have taken place till about 1850 when Col. J. H. B. Hallen, who appears to have been a very outstanding man and a forceful personality, entered Indian Service. In 1862, he established an Army Veterinary School at Poona. Hallen in 1869 was appointed the Chairman of the Indian Cattle Plague Commission which focussed attention on livestock conservation.



Gift of Sir Dinshaw Manockji Petit, Bart



The foundation stone of the Imperial Bacteriological Laboratory, Poona

PLATE 1

The main Laboratory Building at Mukteswar

PLATE 2

It remained for Hallen to visualize for the first time large-scale and first rate establishment for training the Indian agriculturists and proposing machinery for organized livestock work amongst the civilian population. He established a Civil Veterinary School at Babugarh in 1877. Hallen was also responsible for the establishment of a Civil Veterinary Department in 1889 with 18 officers transferred from the Army, and in 1892 he became the Inspector-General of this Department.

Hallen stimulated interest in the veterinary work, and investigation of various obscure diseases was undertaken by many individuals. The outstanding discovery was the demonstration by Griffith Evans in 1881 of the causative agent of equine surra as *Trypanosoma evansi*. The work opened up the study of protozoan diseases of both men and animals and helped the progress of scientific and medical research generally. All these investigations were, however, rather sporadic and due more to individual brilliance and initiative rather than to organized attempts.

Establishment of Veterinary Research Laboratory

The establishment of a Veterinary Research Laboratory in India was recommended in 1885 and was accepted by the Secretary of State for India in 1886. The possibility of vaccinating cattle with Pasteur's anthrax vaccine and the necessity of a laboratory for vaccine preparation were being discussed for a number of years. Even experiments were conducted in Madras and Calcutta and the anthrax vaccine seed was secured from Paris through Messrs. Cooper and Banerji who were deputed by the Government of India to study Pasteur's system of vaccination there. The possibility of preparing a vaccine against rinderpest was also being talked about. Later the College of Science at Poona under Principal Dr Theodore Cook was chosen for investigations on cattle diseases and the appointment of a permanent Microscopist was recommended. Another Committee recommended the creation of the post of a Superintendent of Bacteriological Survey, who was to tour from province to province and make a survey of the prevailing diseases. Dr Cook was deputed in 1889 by the Government of India to tour Europe, to study bacteriology, to purchase laboratory equipment and to advise the Government on the appointment of a permanent Microscopist (subsequently the designation was changed to the Imperial Bacteriologist). Dr Cook recommended the appointment of Dr Alfred Lingard for the post and this recommendation was accepted.

Outside India, the golden age of bacteriology and immunology had already dawned. Working with tuberculosis and anthrax, of men and animals, Robert Koch had not only demonstrated for the first time, a specific microbe as the causative agent but had also enunciated certain general principles of wide applicability as a new method of approach for ascertaining if any suspected microorganism was the cause of a disease. These principles, 'Koch's postulates' require the constant finding of the microbe in the diseased tissue, its isolation in pure culture therefrom, production of the disease artificially in healthy animals with the culture and then its recovery from the experimentally infected animals.

Similarly, Pasteur working with anthrax in sheep and fowl cholera in poultry laid the foundation of modern preventive vaccination. Pasteur showed that virulent organisms could be attenuated and that healthy animals could be protected against virulent infections by vaccination with the attenuated germs. The potentiality of this work aroused world-wide interest.

The above discoveries of specific causes of surra and anthrax, which could only be discovered under a microscope, were perhaps responsible for the post of Dr Lingard to be known as Microscopist. The enlarged scope of the work which followed, necessitated the renaming of the de-

signation as Bacteriologist—the term bacteriology including at that time not only all the pathogenic organisms, but also the means of combating the diseases caused by them (in the sense microbiology is used at this moment). The appointment of a medical scientist as the head of a veterinary laboratory was not at all surprising, because essentially medical and veterinary sciences are not only interdependent for progress, but the use of identical tools of animal experimentation, biologics, etc. make them kindered sciences and complementary to each other.

Early development

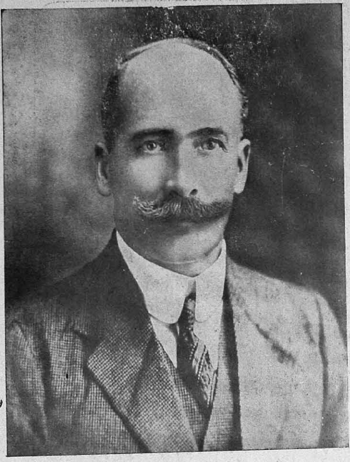
As stated above, the ground was already prepared for the manufacture and distribution of anthrax vaccine, and Dr Lingard had at first naturally devoted most attention to this work. It was soon realized, however, that anthrax in India was of secondary importance and that problems of rinderpest were more important and urgent, but the congested surroundings of Poona were found unsuitable for working with such a highly virulent disease as rinderpest. The laboratory thus came to be transferred to Mukteswar in the Kumaun Hills in 1893. The sentiment against the spilling of bovine blood was perhaps also an added consideration in favour of selecting such an isolated locality. The administrative control, hitherto vested in the Government of Bombay, was transferred to the Inspector-General, Civil Veterinary Department.

Although in certain respects Mukteswar has proved to be an ideal place to meet the technical requirement of the study of rapidly spreading diseases, particularly with the readily available hill cattle capable of yielding most potent sera, doubts have often been expressed about the wisdom of selecting Mukteswar. At the time the site was selected, the projected motor road was to be constructed close to the Institute, but when actually built the road was diverted seventeen miles away from Mukteswar. Experience has shown that this comparative inaccessibility of the place has made the life of the Institute staff costlier and harder, particularly as prolonged stay in such isolation causes mental strain. There is no doubt that the interest of the Institute and of its employees has suffered a great deal due to the reluctance of busy authorities to undergo the irksome trip to Mukteswar. As very few people visit this place, the problems of the inhabitants such as their need for amenities of life and recreation facilities are not appreciated, and, on the whole, the Institute for this reason has not had much luck in securing its proper share of credit and encouragement for its achievements and increasing usefulness.

While the laboratory buildings were under construction Dr Lingard concentrated on the study of surra and demonstrated the specificity of arsenic in the treatment of trypanosomiasis, a discovery which in the hands of Ehrlich in Germany produced one of the greatest benefits to people suffering from syphilis. Lingard had studied bacteriology in Germany and was responsible for getting two noted German bacteriologists, Koch and Pfeiffer, to come to India in 1897 and to advise on the best method for the prevention and control of rinderpest. When these experts arrived, officers working in the field in India were invited and given demonstration of rinderpest immunization as carried out in South Africa. Work on the anti-rinderpest serum started in the same year and the first issue of the product was made in 1899. In the fire which broke out in 1899 the records of research of the previous years as also the building were destroyed. The building was restored in 1901. During the years 1901-1906, the Institute products included anti-sera against haemorrhagic septicaemia, anthrax, and tetanus, the last one having been discontinued later. A vaccine against blackquarter and a diagnostic agent against equine glanders were also prepared. A substation was also open-

A. Lingard

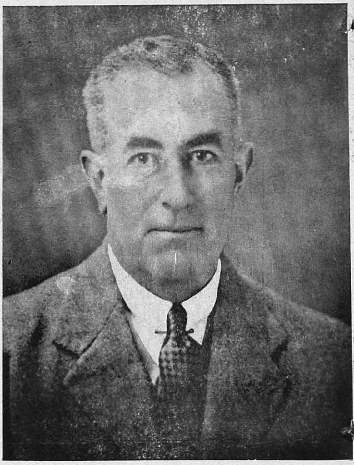
PLATE 3



J. D. E. Holmes

A. L. Sheather

J. T. Edwards



F. Ware

PLATE 4

ed at Kurgaina near Bareilly for carrying out certain experiments during the cold weather.

Lingard Institute of Animal Science

Lingard retired in 1907 after a devoted service for seventeen years and died at the age of 87 in 1938 in the south of France. Although a Welsh man it may be recalled that he lived and worked in the Himalayan forest amongst illiterate hilly people, far away from the amenities of civilized life and with not much possibility of European company, more or less like the Indian Yogis and Rishis of the old. The memory of Lingard should inspire Indian workers at the Institute to face problems and difficulties with the same determination in total forgetfulness of personal comforts and self-interest. Although provided with meagre staff, the new grounds of research that he broke for the first time in India were remarkable. In India and abroad, it has been customary to name famous Institutes after the names of their originators and benefactors such as, Haffkine, King, Rockefeller, Pasteur, Koch and Carnegie. From this consideration and in modern terminology, the Indian Veterinary Research Institute should really be Lingard Institute of Animal Science.

Associated with Lingard, the Assistant Bacteriologist at Mukteswar was another medical man, Sir Leonard Rogers, who has outshone even Lingard and made his mark in wider fields and has been the heart and soul of the Schools of Tropical Medicine at Calcutta and London. Rogers officiated for Lingard during 1898-1900 and later rejoined the Indian Medical Service. He is fortunately still alive.

J. D. E. Holmes:—During the subsequent forty-three years (i.e. to-date), the heads of the Institute have all been veterinarians. Lt. Col. J. D. E. Holmes, who succeeded Lingard in 1907 had joined as Assistant Bacteriologist in 1904. Holmes possessed high qualifications and was endowed with rare foresight and wisdom, and he was able to expand the scope of the work and provide more facilities in the Institute while at the same time, as a practical man, he was able to raise the income of the Institute from about Rs. 5,000 in the year he took over charge to Rs. 74,000 in the next year, by introducing a nominal charge for the biological products issued from the Institute. Hitherto every product was being issued free to the provinces. Hill bulls were the only animals from which anti-sera were being produced at Mukteswar. Holmes showed that 'plains' cattle and buffaloes could also yield efficient products, and thus he paved the way for the commercial manufacture of sera, to be carried out in the substation on the plains with the advantage of cheaper costs and more readily available transport to the field than hitherto had been thought possible. He had also visualized the advisability of setting up a branch laboratory in the plains as a tributary of Mukteswar, to provide such environmental facilities as were lacking in the hills. On his recommendation the Government of India purchased 700 acres of land at Izatnagar in the vicinity of Rohilkhand Kumaun Railway (now called Oudh Tirhut Railway) headquarters. Some residential buildings were erected at this site but due to his untimely death at Bareilly on 23 February, 1915, the Scheme encountered a serious setaback. Holmes stepped up the production of sera and vaccines enormously and was able to meet the demands from countries like Egypt, Sudan and Rhodesia. The income from these sources rose to over Rupees one lakh and twenty thousand in 1914-15, and over two lakh and forty-one thousand in 1915-16, whereas the total expenditures were nearly Rs. 2.28 lakh and 1.34 lakh, respectively. He was a very active worker, a prolific writer, and researched upon a variety of problems, particularly the effect of various drugs on different diseases and was the first to recommend the provision of cold storage facilities in the provinces

for ensuring keeping qualities of the products. During Holmes' time the post of a physiological chemist was created and Sir Percival Hartley was appointed to that post in 1911. During his short stay of two years Hartley did some classical work on the fractionation of immune bodies from rinderpest serum. Hartley is still alive and the distinction that he has achieved in developing similar problems in the United Kingdom is a matter of gratification and pride.

A. W. Shilston who was appointed Assistant Bacteriologist from 20 March, 1914, officiated as Imperial Bacteriologist after Holmes' death, for a period of 19 months. Shilston was a young energetic officer with great devotion to duty but due to his untimely death as a result of contracting glanders from horses his career ended on 17 June, 1919. Besides his work on glanders, *kumri, bursati,* the visibility of rinderpest virus, and on drugs to cure various diseases, he was able to evolve the new oxalate method of collecting blood to increase yields of sera.

The post of the pathologist was created and a medical man, Dr G. H. K. Macalister joined in this capacity on 2 October, 1914, and almost simultaneously Dr R. V. Norris assumed the post of physiological chemist. The world war had already started, and Shilston and both these officers joined the Army. Macalister engaged himself on histo-pathology of *kumri* and certain serological problems, while Norris studied different techniques of the preparation of sera of haemorrhagic septicaemia and anthrax.

A. L. Sheather: Dr A. L. Sheather was the Imperial Bacteriologist for 3½ years and during his tenure the designation was changed to Director and First Bacteriologist, and Mr. W. A. Pool became the Second Bacteriologist in place of Shilston from 30 July, 1919, and the Third Bacteriologist, Mr. T. M. Timoney, joined on 15 March, 1921. Having joined during the first world war, Sheather's energies were directed towards increasing the output of sera and vaccines and meeting the different administrative and supply problems that had arisen. He studied the duration of infectivity of hides, some parasitic worms, tuberculosis, bovine lymphangitis, and described the occurrence of buffalo malaria for the first time, also drew attention to Johne's disease, which had already been encountered by Meadows in the Punjab. In 1919 a Committee of which Sheather was a member, decided that Bareilly was neither suitable for research nor for manufacturing biologicals and that the Izatnagar project might be abandoned at once. Subsequent developments, however, have not borne out the decision of this Committee.

Sheather proceeded on leave in 1920 and on the expiry of his leave was placed on special duty to purchase laboratory equipment in the United Kingdom. Family reasons prevented him from returning to India. He was succeeded in an officiating capacity by Mr. W. A. Pool, who was able to get the Government to agree to the retention of the Izatnagar site and to the development of the work there. The small Kurgaina site, which now accommodates the Military Dairy Farm was then auctioned. Pool was mainly engaged in developing the serum-simultaneous method of rinderpest inoculation and bacteriological studies on equine abortion. Soon after the post of Director was permanently filled by Dr J. T. Edwards on 19 November, 1921, he resigned and returned home. Mr. Pool is still alive. He popularized himself at Mukteswar by his earnestness and deep understanding and even after so many years he still retains an undiminished interest in the Institute and its workers as Director of the Commonwealth Bureau of Animal Health at Weybridge in the United Kingdom. Mr. T. M. Doyle, a charming personality, who is well known for describing for the first time Newcastle disease of poultry, joined the Institute as Veterinary Officer during this time but did not

continue after his probationary period.

J. T. Edwards: The new Director and First Bacteriologist, Dr J. T. Edwards, may be said to have been the harbinger of a new era of painstaking and many-sided activities, the results of some of which have influenced in no small measure the progress and character of veterinary work in several countries. A highly intelligent scholar of great intellectual force and large conceptions, Edwards was responsible for giving a new impetus to veterinary research, and the respect and confidence that he commanded in the profession was unique. His knowledge of French and German, his flair for stylish writing and his oratorical powers of expression were of a high order. He was fortunate enough to be provided with some devoted and selfless associates, both European and Indian and an admirable team developed therefrom.

In 1925, the name of the Imperial Bacteriological Laboratory was changed to the Imperial Institute of Veterinary Research and the name of the Head to the Director.

The minor and major researches of Edwards and his associates, in diverse directions are far too many to be recounted here. Suffice it to say that his efforts to implant and fix rinderpest virus in hosts other than cattle, such as in rabbits in 1924 and in goats in 1927, his studies on piroplasmosis and theileriasis and the improved method of treatment of surra are remarkable. The goat virus method of immunization has become the universally adopted method in India and some other countries. Field work all over the country was energised and made much more effective. Within the Institute he made arrangements to foster the natural development of the facilities for future workers, e.g. systematic recording of experimental data, thorough post-mortem examination of animals as a routine, and the preservation and cataloguing of representative pathological specimens of all kinds from all parts of the country, improvement in the library facilities and indexing of important scientific articles from the current literature of the world. He developed the Izatnagar substation as a centre for research and for the mass production of biologicals all the year round. On his recommendation certain new posts were created, viz. Assistant Research Officers for protozoology, helminthology and biochemistry. His personal interest to provide more amenities of life and recreation facilities to the large Institute staff will be long remembered. The first description of Ranikhet disease was given by Mr. H. Cooper, the pathologist who was not only an intimate and steadfast comrade but also contributed in large measure to the achievements recorded during Edwards' time. Edwards resigned from service on 31 March, 1929, and this news was received with sorrow all over the country. The Institute Director was made independent of the control of the Agricultural Adviser in 1929 but unfortunately Edwards did not continue in the appointment long enough to derive the benefit of this arrangement.

Sir Frank Ware: Endowed with the powers of a departmental Head by the Government of India, Sir Frank Ware stepped with enthusiasm into the vacuum created by the departure of Edwards, to expend nine years of very eventful service. The special qualities of maturity and calm determination, which characterised Ware elicited Government support in a large measure for his recommendations in the central and provincial spheres. An alround improvement and increased tempo of work became gradually manifest. He worked in closest cooperation with the State departments and also with the Indian Council of Agricultural Research, and several schemes of research were financed by the Council at the Institute. His chief endeavour was to provide for the livestock of India, both at the Centre and in the provinces, an organization capable of dealing with any aspect of their improvement and to build up a staff of

scientists so trained as to be capable of directing such an organization. His creative vision strengthened by the recommendation of the Royal Commission on Agriculture led to the setting up at the Institute of a well integrated team of experts in different branches of basic and fundamental sciences relating to livestock which was so essential for the development of veterinary research. It is so obvious and yet not realized that attempts at the production of economic milch cows or efficient work or food animals, must be directed from all angles to the improvement of the integrated functions and organs of these biological entities. A combined approach is, therefore, indispensable to attain the desired goal.

It may be added that at this time a proposal was mooted by Colonel Sir Arthur Olver to set up a Central Veterinary College in conjunction with the two Institutes at Izatnagar and Mukteswar but this did not mature.

Imperial Veterinary Research Institute

In 1931, Ware divided the work at Mukteswar into three sections, viz. pathology, serology, and protozoology, each headed by a Veterinary Research Officer. He later planned the addition of new sections for animal nutrition, animal genetics and poultry research. Two of these matured during 1936-38. Then it was laid down that the Institutes that are located or will be located in future at Izatnagar are to be described as Sections of the Institute and the heads of these Sections are to be designated as Officers-in-Charge. In 1936, the Imperial Veterinary Serum Institute, Izatnagar, thus became Biological Products Section and its Deputy Director an Officer-in-Charge. The parent Institute which was then known as the Imperial Institute of Veterinary Research was renamed Imperial Veterinary Research Institute.

Ware by training was essentially a parasitologist and had profound appreciation of the requirements of field work. He had a warm heart for the worker who delivered the goods and was rather firm and a strict disciplinarian. Even amongst his multifarious duties he had the gift of sharing with his associates the joys of their discoveries. In this connection, a personal reminiscence of the author may not be out of place. He has still vivid recollection of 23 December, 1931, when Ware was visibly moved with joy at the discovery by the author of a schistosome as the cause of the hitherto elusive bovine nasal granuloma. The writer then proposed to create a new species *S. warei* * for this worm.

In 1938, Sir Frank Ware left the Institute to assume the appointment of Animal Husbandry Commissioner with the Government of India. Even while in Delhi and during his later service period in the Uttar Pradesh his active interest in the Institute never waned. So many years after his retirement the welfare of the Institute and the progress of the livestock development in India form subjects of his warm-hearted enquiries from his home in England.

Mr. J. R. Haddow officiated as the Director from 1938 to 1939. He had joined as Veterinary Officer in 1923, but later became the First Bacteriologist and the Deputy Director-in-Charge of the Izatnagar substation successively. From 1931, he became the Veterinary Research Officer-in-Charge of the Serology Section. When Dr F. C. Minett joined the Institute in September, 1939 as Director on a five years' contract, which was later extended, Haddow became the Deputy Director of the Institute and gave him valuable assistance. Later Haddow left the Institute for service under the Bengal Government and the post of Deputy Director was abolished. Haddow was a

* The systematic Helminthologist at the Institute, however, did not agree to this identity and it was thought advisable to leave it for the future to decide. Mr. Rao of Madras eventually succeeded in creating a valid species of *S nasalis*.

F. C. Minett

PLATE 5

very unassuming and quiet man who could be counted upon as a good friend and a wise counsellor. His scientific achievements relate to the study of viruses particularly goat tissue virus vaccination for rinderpest and Ranikhet disease vaccine.

F. C. Minett: Minett had been the Director for eight years till 15 August, 1947, when he opted for Pakistan and left India to become the Animal Husbandry Commissioner of that newly-formed Dominion. He held charge of this Institute during a very critical period. He joined after the second world war had just started, and due to the wartime difficulties the Institute could not be developed much during his time, and the country therefore deprived from reaping the maximum benefit which was expected to be derived from his talent. The scheme for the biological products and animal genetics buildings sponsored by him though approved by the Government did not materialise. In 1945 he submitted a scheme for the reorganization and development of the Institute which was also held up in a maze. During his tenure the Animal Genetics Section was established in 1944 and poultry farming was further developed by Mr. A. J. Macdonald. The downgrading of the General Disease Investigation Section as a subsection of the Pathology and Bacteriology Section resulted in an unforeseen setback to pathological investigation in the country in general and at the Institute in particular. After Haddow's departure in 1945, Minett took over charge of the Pathology and Bacteriology Section in addition to his own onerous duties in research and administration as Director and this resulted in the absence of a whole-time head for the double section for an appreciably long time.

In his time new courses of training and Institute Associateship by research were introduced. As Chairman of the Indian Council of Agricultural Research Education Committee he prepared the ground for the extension of Veterinary Science in the curriculum of different Indian Universities.

On the research side his work on the physiological responses of domestic animals to climatic extremes and breed susceptibility and his initiation of studies on the epizootiology of certain diseases like black-quarter are of more than ordinary interest. Minett's regime was seriously handicapped by several senior officers, whom it had taken a long time to train for special branches of work, leaving the Institute during this period on securing better prospects elsewhere. This created a void that would take long to fill. Social activities of the Institute received a fillip during his tenure.

Indian Veterinary Research Institute

This brings us to the era of Indian Independence which opened on 15 August, 1947, after the Institute had served the country for full fifty-seven years. For the first time the development of the enormous livestock resources of India then became Indian responsibility. As the first Indian Director of this Institute heavy responsibilities have naturally come to devolve upon the present writer. Space does not permit any detailed mention of the research work of the present period of three years. This has been included *inter alia* in the sectional reports which follow.

The administrative problems arising out of the disappearance of the old political order, the sudden departure of a portion of the trained staff to Pakistan on the partition of the country and the requirements of accommodating displaced field staff from Pakistan in their stead into the fabric of scientific research were many and urgent. Legacies of the war and of partition and financial stringency all played their part. Adjustments had to be made on varied and diverse planes The provincial Governments received Central grants for postwar reconstruction, but the Institute could not get its reorganization

proposals implemented at all. The rapid expansions in the States naturally demanded increased service from the Institute and its depleted staff had to meet it working with vigour and using their resources to the maximum.

Evaluating the result of the work of sixty years, it may be noted that the researches conducted have been of an essentially practical and economic nature and not academic as is sometimes wrongly believed. If it were possible to assess the improvements in the bodily condition, stamina and productivity of animal population of India resulting from the toils of Institute workers for the last sixty years it would certainly be gratifying. The bounds of research have been extended into ever widening fields of human health, nutrition and welfare. Innumerable researches of the Institute have received recognition and appreciation in the international field. A number of its completed works have found mention in various textbooks and other publications. Scientists of repute who have visited the Institute at different times have been well impressed with the quality of the work done, and to quote Dr Tunnicliff of the U.S.A. who visited the Institute in 1944: 'I am positive that this institution ranks among the three best animal disease research institutions of the world. India should be very proud of this Institution.' The work of the Institute has since then been further developed.

The Institute has developed by a process of gradual and natural evolution over these long years into a major centre of research and education in animal husbandry problems, providing valuable scientific knowledge, technique and practical training as well as the tools and latest information needed for the conservation and development of livestock. The developments in the provinces and States have in no small measure been based on or influenced by what has been provided by the Institute in various ways during these long years. The staff constitutes workers from all parts of India who face various problems together at this All-India centre. A substantial measure of success has been achieved in making animal life secure against rapid decimation, reduced productivity and period of disability. The constructive aspect of economic rearing and development of the productivity of livestock have been drawn into the ambit of the Institute through the study and elucidation of the difficulties and obstacles. Wastages of valuable resources have thus been controlled.

The Institute has attained considerable dimensions, and the size of the staff has grown but the problems that have yet to be faced and the lines of work which have yet to be undertaken and developed are many, e.g. standardization of biologics, veterinary pharmacology and toxicology, indigenous drugs, immuno- and bacteriological chemistry, climatic physiology, improved training facilities, etc. A revised scheme for the reorganization and development of the Institute to meet such demands was submitted in September 1948, and it is hoped that this will be implemented in due course.

Cattle diseases are as much a food problem as any other thing, as agriculture is put out of gear by the disability of cattle and results in low production. Scientific methods of breeding and feeding increase the productivity of animals. Crores of rupees have been saved each year by preventing deaths of animals and losses in animal productivity.

Expenditure and return

It will be of considerable interest to investigate, at this stage, the amount of public money that has been spent as recurring expenditure for the working of the Institute in its relation to the actual receipts in the same period. Figures for the last 47 years (i.e. from 1901-50 with the exception of the years 1908-10), which are readily available, show that the total

expenditure (excluding capital expenditure) for this long period was Rs. 3,52,86,850 against corresponding receipts of Rs. 2,48,98,263 (excluding free supplies made to the provinces till 1911-12 and the Army till 1921-22). On taking an average this works out to Rs. 7,50,784 expenditure per year against the yearly receipts of Rs. 5,29,750 which shows that during the 47 years the net expenditure of the Government on this Institute had been only Rs. $2\frac{1}{4}$ lakh per year. If the free supplies to the civil departments upto 1911-12, and to the Army till 1921-22 are added to the receipts the expenditure becomes still less.

In attempting to understand the significance of these figures of receipts of the Institute, it must be noted again that the biological products used to be issued free to the provincial and military authorities until 1911-12. The Army however continued to get supplies free of charge upto 1921-22. At the suggestion of Colonel Holmes in 1911-12 charges were made at two annas per dose of anti-rinderpest serum and the yearly income which was about Rs. 5,000 for the previous few years suddenly increased to Rs. 74,000. With effect from 1917 a charge was introduced for other products as well. This income remained progressively on the increase year after year till 1929-30 when it exceeded the $15\frac{1}{2}$ lakh mark. Again during 1925-33, the Institute produced a net profit of upto eight lakh a year. Later, the Government of India felt that the making of profits at the expense of disease and in view of the poverty of the agriculturist, was not justified, and whatever profits were made should be returned to the provinces in the larger interests of the country and to enable more extensive efforts in livestock conservation. The income thus became greatly reduced on account of the Biological Products Section being run on cost and commercial basis. In recent times, however, the fluctuations in the cost and the wages have been so great that correct assessment with a view to evolving a suitable policy regarding the future price structure of the Institute products would be difficult and as a result the return of stable conditions has to be awaited.

As far as possible, the manufacture of different products according to the facilities available in the States has been actively encouraged by the Institute, and a few States notably Mysore, Madras, and lately the Uttar Pradesh have attempted to be self-sufficient in certain directions. The demand on the Institute for products has still not been reduced because newly integrated States have come into being, and more particularly because the use of control measures has been extended all over the country, resulting from a greater consciousness and appreciation by livestock owners of the transcending benefits of modern preventive technique, and also due to additional and newer products having been added.

The assessment of the benefits of control of contagious plagues whether of man or animal cannot be made merely on the basis of monetary gains obtained from the sale of biologics. The correct approach is the well-being and efficiency of the general population which is saved from disease and death. Taking rinderpest as an example, it may be said that in spite of an increased application of the advanced method of control, it still continues to be the most important contagious disease, and it would be no exaggeration to say that about two lakh head of cattle still die of this disease every year besides a large number that is left behind debilitated, and rendered unproductive for a considerable period of time. It is, therefore, of great national interest that the eradication programme of this disease and of others be given effect to without any delay. Though a major portion of the provincial veterinary budget has even now to be utilized for rinderpest control measures, the loss of animals amounts to (at the moderate cost of Rs. 100 per animal) Rupees two

crores per year from deaths alone. This is quite a high figure, but it may be remembered that the above mortality is estimated to be under 10 per cent of what it used to be before these immunization methods had been introduced. It is obvious from even this rough calculation that the money expended over the sixty years is only a small fraction of what has been and is being saved in animal life through the joint enterprise of this Institute and the provincial authorities.

Basic national wealth

It must be noted that India possesses the largest livestock population as compared to any other country and the potentialities of some of this livestock are enormous not only for meeting the needs within the country but also for developing a substantial export trade. Several countries have based their national economy on the livestock industry, and having started from conditions somewhat similar to what exist in India today, have attained high prosperity and development. If India's vast tracts of country and all the different States and their millions of livestock are taken into consideration, the above-mentioned annual expenditure would appear to be hardly adequate, notwithstanding what is being spent by the States themselves.

The contribution made by the improved or sustained productivity of animals in the shape of multiplication of numbers, and by the provision of animal products for human use, or by animal labour is very roughly estimated to be about Rupees 5,000 crores per year. This figure may be carefully noted and compared to the income from certain industrial and agricultural commodities which loom so large in the popular mind. Taking figures of 1949-50 the iron and steel industry which is no doubt very vital to the country had a net annual earning of Rupees 58 crores, while for the same period cotton textiles and yarn were valued at 150 crores, jute at 78.2 crores and sugar at 34.5 crores. The annual coal production is of the order of three million tons, valued at Rupees 500 crores only. Thus livestock and their products form the most valuable and basic national wealth, and as direct responsibility of the States may be considered their own assets. How the Institute is assisting the States in the conservation and utilisation of these vast national resources is discussed below.

Link with the States

It is difficult to indicate adequately how vital has been the Institute to the functioning of the provincial departments and how largely the Institute has been responsible for most of the outstanding developments in livestock conservation. As an illustration, the Ranikhet disease vaccine developed at the Institute may be cited. This has practically saved the poultry industry of India and many other countries, and it is being produced now at many centres throughout this country which have been set up on the advice of the Institute, staffed by men trained at the Institute, and by constantly checking the quality of the local products, and replenishing the seed material from time to time. Such decentarilization has been encouraged, and carried out in case of other products as well. In view of the unity of the economy of India as a whole, any unnecessary duplication of efforts or waste of public funds likely to result from such contingency should be scrupulously guarded against as far as possible by central coordination, as is being done in other spheres. The Institute still supplies on demand the seed material for the rinderpest goat virus which is produced locally even under rural conditions, wherever required. The actual products manufactured at the State sera and vaccine production centres and their output are variable. Yet the Institute issues enormous quantities of 25 different products to those who require them in India and outside. It however, continues to pursue feverishly its own objective of bringing out improved and new vaccines all the while making them more eco-

nomic and of wider application as well as of better keeping quality and potency.

This closely integrated work of the Institute and the provinces is thus continuously multiplying and expanding. The forging of well-spread extension service in the States is essential. The popularization and wide dissemination of practical results achieved at the Institute takes place through the State departments. Whenever a new product, e.g. improved biological poultry or a method, say artificial insemination, is ready, actual field trials are carried out in the States where found necessary using animals of varying susceptibilities under local conditions, and making it possible for the local officers to have a practical demonstration on the spot. Similarly to take another instance, the latest rabbit vaccine against rinderpest has been tested with gratifying results in several States during 1948-50, and further extension to all the other States will be carried out before the rinderpest eradication programme which was prepared in February, 1949, can be put into effect. The new tools of artificial insemination, endocrinology, improved breeds, technology and feeding methods are thus all being more and more widely applied.

The training of the provincial staff takes place in several ways, and assistance in the solution of local problems is always provided by supplying men, materials and tools. When apparently contradictory results are obtained at one or more places, the Institute takes up the problem and probes into the significance of those results and finds out the actual cause. Sometimes the technique elaborated by the Institute is not adopted by the livestock owners. This is not because of any defect or impracticability of the methods but mainly due to the absence of the required organization of an adequate size, appropriate to the enormity and content of the problem. For example, the prevention of serious losses due to liver-fluke and other parasites, which are common and for which efficient methods of control with full information are already available, requires an organized field campaign over such large areas of lowlying districts which are beyond the resources of individual farmers or even collections of them to tackle. Lack of realistic appreciation of the nature of the problems does lead to undeserved criticism.

It is necessary to realize therefore that the fruitful application of the results of research extends far beyond the purview of any branch of science, and is complicated by the problems of rural life and economy which have to be faced from different angles in a well-considered and comprehensive manner. Reforms in every branch of national activity have been taken in hand and the rapidly growing scientific activity by the establishment of so many national laboratories since the Independence is admirable. This proves the truth of the statement of Grundling about two hundred years ago: 'Only liberty causes science to bloom, and minds to put forth their full strength'. In spite of the achievements, relative economic importance and rich potentialities, livestock development work remains the Cindrella of all sciences.

Time has come of convincing authorities, by the marshalling of irresistible facts and figures, of the potentialities of the hitherto underdeveloped and neglected livestock population possessing a key to national prosperity. Even in this industrial age, healthier and sturdier animals in larger numbers will be required for preparing, maintaining and manuring of more and more land for food production and cultivation. With the rising population at the present rate, the problem of food is likely to predominate increasingly in our national thought and effort, and an emphasis on the livestock for maximizing the productivity from land and animals will be indispensable. The raising of the standard of living and of the health and efficiency of the people depends largely upon the provision of better balanced food of high nutritional quality, i.e. provision of sufficient

quantities of milk, meat and eggs. National prosperity depends to a large extent on a thriving livestock industry providing employment to millions of people, and better returns of agriculture are made possible by mixed farming. In our Constitution there is a directive that the State shall endeavour to organize agriculture and animal husbandry on modern scientific lines and shall in particular take steps for preserving and improving the breeds of cattle. The demand for complete animal husbandmen must therefore grow more and more, and the role of the Institute for this purpose as also for implementing the above directive becomes clearer.

In the present state of evolution, the boundary of the Institute is not restricted to its two branches at Mukteswar and Izatnagar, but it has now spread itself by its work and trained men whether as Directors of departments or Principals of colleges or as members of the field staff, throughout the length and breadth of the country. Without assistance from the Centre in matters of research, training and tools, a coordinated national plan cannot gain the necessary momentum to beget tangible benefits. The Institute has by its record and promise amply justified the hope that it will continue to be the fountainhead, where provincial staff in increasing numbers will come and go back better equipped with more effective tools, to their actual jobs with greater enthusiasm and a realistic outlook. The enlargement of the Institute and the extension of training facilities which have been held up should therefore be effected as soon as possible. Above all, India has as well a duty towards her neighbbouring countries who have for centuries looked for spiritual inspiration to her. Today with the problems of rehabilitation of their countries exercising them, they are eagerly watching developments in India with a view to getting full assistance in training and tools as also sufficient numbers of improved tropical breeds of which they stand so much in need. Will India, holding the geographical position and the status that she does among the nations of Asia, be oblivious of this rising hope and expectation among her neighbours? The house should be put in order first, and the speedier it is possible to do so, the better it will be.

PATHOLOGY AND BACTERIOLOGY SECTION

By M. R. DHANDA

THE latter half of the nineteenth century can rightly be called the golden age of bacteriology. The brilliant researches of Pasteur, Koch, Lister, Calmette and others filled many a gap in the knowledge of diseases. Bacteria and viruses loomed large and occupied the pathologists' mind fully. Rightly, therefore, the first Research Institute established in 1889 in India was named The Imperial Bacteriological Laboratory and its first Director the First Bacteriologist. The other research staff sanctioned later consisted of the Second and Third Bacteriologists. Work, then consisted mainly of the study of epizootic animal diseases, particularly anthrax and surra. With the expansion of the Imperial Bacteriological Laboratory researches in various other aspects of animal health were also undertaken. Thus the duties and responsibilities devolving on the Imperial Bacteriological Laboratory of the time have come to be the domain of the present Pathology and Bacteriology Section. With the creation of the post of the Pathologist in 1915 G.H.K. Macalister was appointed to it, followed by a galaxy of eminent men like, H. Cooper, S. Datta and J. F. Shirlaw. The increase of activities of the veterinary departments in the States necessitated the constitution at Mukteswar of three sections of pathology, serology, and protozoology in 1931. The section of pathology carried out extensive advisory and diagnostic work in addition to its research activities which resulted in some outstanding advances on the hitherto obscure problems. In 1939, the sections of pathology and serology were redesignated respectively as the General Disease Investigation Section with headquarters at Izatnagar, and the Pathology and Bacteriology Section at Mukteswar. The former section worked in close collaboration with the State veterinary investigation officers in the investigation of field problems, and the liasion established between the States and Centre served a very useful purpose of coordinated and well-directed work all over the country. It is unfortunate that the post of the officer-in-charge of this section was downgraded and this section was merged in 1945 with the Pathology and Bacteriology Section though its staff remained at Izatnagar. The absence of a full fledged section of pathology has produced a great setback and the coordination between the field work in the States and the central institute has been greatly upset.

In addition to the regular activities of the Section, three following schemes of research financed by the Indian Council of Agricultural Research have been in operation for the last few years: (1) Tuberculosis and Johne's disease (2) vacination of cattle against foot-and-mouth disease and (3) diseases of animals caused by anaerobic bacteria.

M. R. DHANDA is Officer-in-Charge' Pathology and Bacteriology Section.

Functions and line of approach

The Section deals mainly with the diseases due to bacteria and viruses though preliminary field investigation work is undertaken in respect of diseases due to other causes as well. The bacteriology and virus diseases laboratories carry out researches on diseases of bacterial and viral origins, their chief aim being to discover effective control measures. When a new disease has come to notice the first step is to ascertain its cause. After an animal's death, a study is made of the

changes that may have resulted in the various organs of the body as a result of the infection. Every casual agent of disease, be it a bacterium or a filtrable virus, is usually most concentrated in some organs or tissues which form its seats of predilection. Affected organs are collected without letting them get contaminated with extraneous germs which may normally be present in Nature.

Study of bacteria

The isolation of bacteria is carried out by sowing sparsely, the diseased material on the surface of such culture media as are most likely to supply the peculiar food requirements and maintain growth of the suspected microorganisms. Most pathogenic bacteria thrive well on media containing animal products, while some require more complex growth factors and special enrichment media. Favourable environmental conditions for each growth are made available. The requirements for optimum growth are different for various bacteria—some grow at certain ranges of temperature while the rest thrive best at others; some cannot multiply in the absence of oxygen while others prefer to be without it. After incubation under proper conditions, colonies develop which are carefully studied. A typical colony picked up and transferred to a suitable medium gives a pure culture.

Often, isolation is not so simple and other methods including the use of experimental guinea-pigs, rabbits and mice have to be resorted to. Sometimes the normal hosts may be used and this is where a veterinary research worker has advantage over the medical man in studying a disease though most medical researches have also to be based on animal experimentation. A clue as to the pathogenicity (disease producing capacity), the mechanism of infection and whether toxins are liberated or not and similar other factors are determined before a line of approach to the evolution of combative measures against the disease can be worked out.

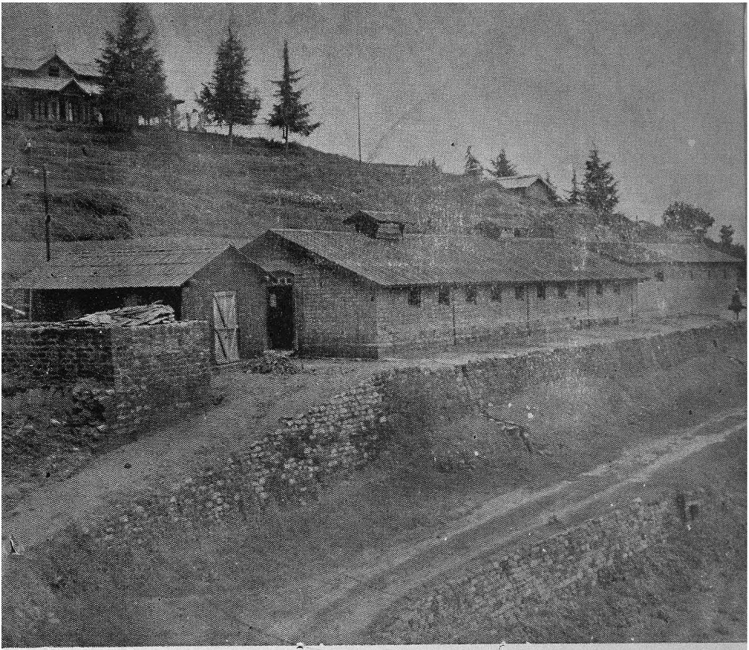
The identification of the organism entails a detailed study of its general form such as shape, size and structure within its body—for, bacteria, minute as they are, have a complex internal structure—its nutritional requirements, cultural characteristics, its biochemical activities and finally, its disease producing capacity as well as the resultant effect of the attack on the host after survival or death.

Study of viruses

Whereas bacteria can be seen under the ordinary microscope and studied in the manner stated above, viruses are too minute to be seen in this way. The study of their shape and size requires the use of modern methods such as the ultraviolet photography and the use of the electron microscope and a high-speed centrifuge capable of revolving at 160,000 revolutions per minute. Their isolation is carried out by special methods such as passing them through graded filters which allow only the virus particles to pass through, while the bacteria and other cells are kept back. Viruses cannot grow in the absence of living cells and are therefore most commonly cultivated in the body of a susceptible animal for obtaining them in large concentrations for their general study and for making prophylactic vaccines.

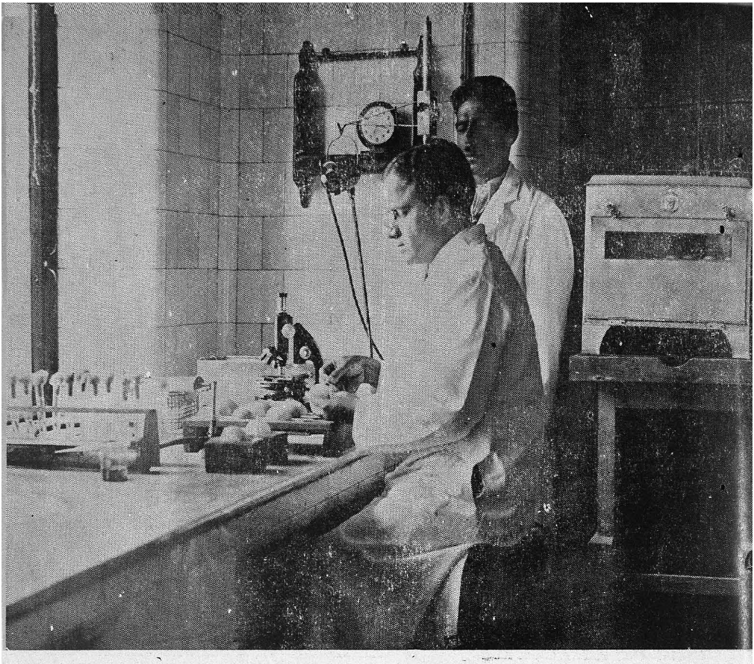
Evolution of vaccines

Once the casual organism or virus has been obtained in pure culture and its general characteristics studied, efforts are made to evolve a suitable vaccine for the effective control of the particular disease. This is not a simple affair and requires careful study of the components of the bacterial cell or virus particle, capable of stimulating the production of protective bodies or antibodies (antigenic structure) when introduced into the animal body. Vaccines may be prepared after killing the organisms (dead vaccines), or from living



A cattle shed at Mukteswar

PLATE



Preparation of Ranikhet disease vaccine

PLATE 7

organisms. In the latter case, usually certain changes have to be induced in the organism by various treatments, necessitating its growth for several years under artificial conditions so that its disease producing capacity (virulence) may be reduced (attenuated strains), or completely lost (avirulent strains) without the antibody inducing (antigenic or immunogenic) properties being affected. It was after the cultivation for several years on a glycerol bile potato medium that B.C.G. was evolved from a bovine strain of tubercle baccilli for vaccination against human tuberculosis. In the case of viruses, this may be achieved by propagating the virus in animals less susceptible to it, and the required result may be obtained after numerous serial passages. Vaccine strain of rabies virus, rinderpest goat vaccine and the latest rabbit adapted rinderpest vaccine have been evolved in this manner. Ranikhet disease vaccine strain has been obtained by passing it serially in the developing chick embryo.

Type variations

Different strains of bacteria and viruses, capable of producing one and the same disease may differ very materially from one another in regard to the effects they produce on the protective mechanism of the host. Thus, three different types of foot-and-mouth disease virus are recognized and the immunity produced by any one type is not effective against another. In such cases polyvalent vaccines may have to be produced.

Use of sera

The serum of an animal recovered from a contagious disease usually contains certain protective substances against the disease and its administration to a healthy animal affords protection against that disease. The use of such sera is not favoured much due to the short duration of immunity produced and their high cost of production, but in controlling outbreaks they are indispensable. Such sera against certain diseases are still produced at the Institute in large quantities. Attempts are being made to concentrate these sera as well as to purify them by isolating the active principles by the application of physico-chemical processes on most modern lines, and a variety of new equipments involving the best modern engineering skill have to be procured from abroad to ensure efficiency, economy and sufficiently large mass production.

Diagnostic agents

It is necessary to diagnose a disease before any symptoms have become apparent, earlier the better, especially when it is feared that the presence of an affected animal in the herd even for the shortest while would endanger the health of others. A diagnostic agent prepared from the causative germs makes the diagnosis possible in some diseases, notable examples being tuberculin in tuberculosis, Johnin in Johne's disease and mallein in glanders. These products are prepared in large quantities in the Institute for extensive application in the field both by the Army and the civil authorities.

Standardization of products

In order that the products may be safe and fully potent they are subjected to rigorous tests and this forms an important duty of this Section Each new lot of biologicals prepared at the Institute is tested thoroughly. When each brew of product is thus found to be harmless and efficacious under conditions more exacting than those obtainable in the field, it is passed for issue to the field. The increasing demand for these products and the results of immunization afford ample proof of their high efficiency in checking outbreaks and in the saving of millions of valuable animals.

Achievements of the Section

The early work of this Institute can be

considered as entirely that of this Section but is beyond the scope of the present article. Rinderpest, haemorrhagic septicaemia, anthrax, black-leg, foot-and-mouth disease, surra, piroplasmosis, dourine, *kumri,* lymphangitis, as a matter of fact, almost any disease that animals in India are subject to has been studied.

The work of Edwards in connection with the evolution of goat adapted virus for the protection of cattle against rinderpest and on the treatment of surra has stood the test of time and must be mentioned here though he was the Director of the Institute. Cooper's study of the role of protozoan parasites in complicating rinderpest vaccination by the serum virus method and his original description of Ranikhet disease the hitherto most formidable poultry disease are outstanding contributions. The elucidation by Datta of a group of obscure diseases, which had persistently defied elucidation for many years, e.g. *bursati,* equine lichen tropicus nasal granuloma, hepatic cirrhosis in equines and bovine endemic haematuria are noteworthy. Equine encephalomyelitis and contagious ecthyma of goats were recorded by him for the first time in India and his pathological investigation on acute theileriasis in imported cattle led to significant indications regarding the identity of the parasite.

Ranikhet disease : For years together it was considered that profitable poultry rearing in this country would never be possible on account of the serious losses inflicted by the Ranikhet disease. Due to the ingenuity of S. G. Iyer in collaboration with Dobson, and the strenuous labour put in by Haddow, Idnani and others, the Institute has recently been able to produce an effective prophylactic vaccine which after one inoculation protects birds for the rest of their life. Several local centres have been opened for its production in different parts of the country, and the vaccine has also been issued to many foreign countries. Millions of doses have been used with very satisfactory results. The development of this vaccine may rightly be considered as one of the most valuable achievements of the Institute.

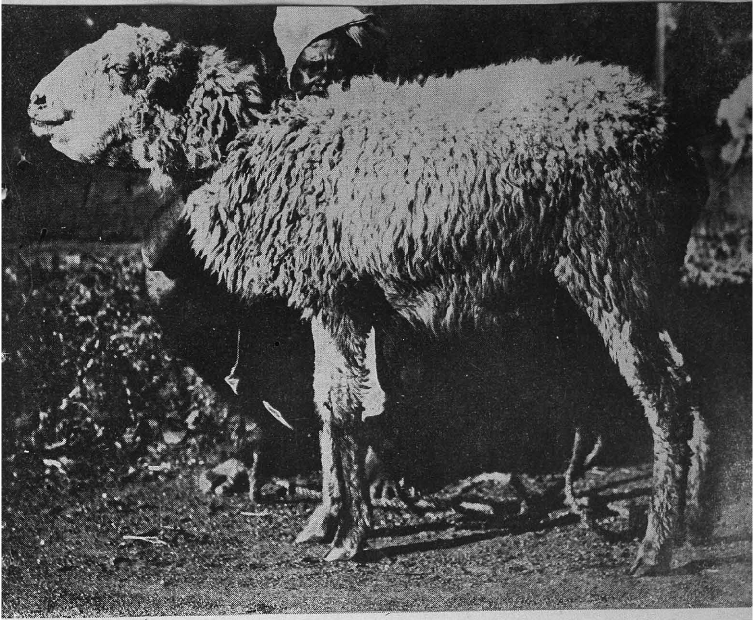
Eradication of rinderpest : Rinderpest accounts for very heavy losses amongst the cattle and buffaloes of this country. Other cloven-footed animals are also susceptible to it. It has formed an important item of research from the very inception of the Institute. Several products have been evolved from time to time for its effective control and the goat tissue vaccine is still being extensively used in this country and elsewhere. However, this vaccine has its limitations and cannot be used with impunity on all types of animals.

A new vaccine evolved by the adaptation of the virus in rabbits, research on which was first initiated in this laboratory and perfected in Japan, is now being extensively tried at the Institute and in the States and has given a great promise for successful vaccination of all species and of animals of all grades of susceptibility. It is clear that by its judicious application in wholesale vaccination this devastating disease will be eradicated from our country and not only millions of cattle, sheep and goats will be saved but large numbers which will survive the attack will not get impoverished and will not be prone to other maladies.

A scheme for eradication at a total cost of Rupees four crores spread over a period of 5-10 years has been prepared and is under the active consideration of Government.

Other Investigations

A large number of other diseases of bacterial and viral origin have been investigated. Haemorrhagic septicaemia, next in importance to rinderpest in the cattle and buffaloes, has received a great deal of attention. Further improvement is indicated in the vaccine issued against this disease as the immunity conferred was not of sufficiently long duration. A killed vaccine prepared from a virulent strain



Sheep with 'Bottle Jaw' (*pitto* or *gillar*)

PLATE 8

has not been any better. In the meantime intensive study of the causal organism, *Pasteurella septica,* has revealed the existence of at least five different types of the organism, and this probably is mainly responsible for the breakdown in immunity produced by the use of the single strain vaccine. A very efficient vaccine using thick suspensions of the culture has been evolved against fowl cholera caused by a similar organism. It has been tried extensively under field conditions and will be released soon for field use. Tuberculosis of cattle has been intensively investigated during the last decade. The large-scale survey work carried out has revealed that the disease is not as rare in this country as once supposed. Unless adequate measures are taken to control this disease from now on, it may assume serious proportions and become a menace to men and animals. Consumption of milk infected with tubercle bacilli of bovine origin and close association with active bovine cases may lead to the disease in man. Other studies made include contagious abortion of cattle, sheep, goats and mares, contagious mastitis of cattle, and Johne's disease of cattle, sheep and goats.

Among the virus diseases, special mention may be made of the foot-and-mouth disease which though not so highly fatal among the Indian cattle, is the most widely prevalent disease affecting several species of animals and occasioning heavy economic losses. The virus occurs in three different forms in this country. Comparative tests carried out with the crystal violet vaccine prepared on an experimental basis at Mukteswar have shown it to be more effective on the Indian cattle than some of the vaccines prepared in Europe.

Passing mention may also be made of contagious pleuropneumonia of cattle and goats which are highly fatal diseases caused by the organisms coming mid-way between the bacteria and the viruses. The disease in cattle appears to have been non-existent in India and may have been introduced to Assam from the neighbouring countries during the last war. After a careful study of the disease a vaccine, which is administered in the tip of the tail, was prepared and used in Assam. The disease in goats has been studied and a suitable vaccine is being tried under field conditions.

Role of biochemistry

Of late, biochemistry has assumed a very important position in researches on immunology and pathology. The study of the nutrition of disease-producing bacteria, freeze-drying of viruses as means of improving the keeping qualities of vaccines, the concentration of protective sera to ensure their easy transportation, study of anti-bacterial principles of some higher plants are some of the problems receiving attention at the present time.

BIOLOGICAL PRODUCTS SECTION

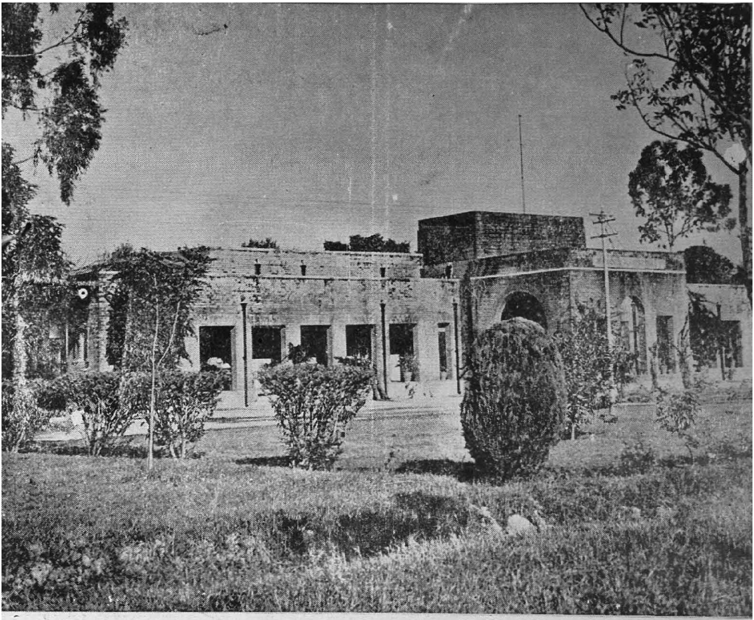
By BALWANT SINGH

THE problem of disease and human endeavour to fight it has been a perpetual problem since time immemorial. In the history of medical science, there is probably no greater achievement than immunology, except for the brilliant studies made recently in the domain of chemo and antibiotic therapies. But even with the advent of recent wonder drugs the task of an immunologist has, however, not become easier but, in fact, has attained greater complexity as great many hurdles have appeared in his way, such as drug-fastness following treatment. Patterns inherent in the microbes change with the passage of time, so also their behaviour and this is undoubtedly favoured by nutritional, genetical, and environmental stimuli. Moreover, in the domain of veterinary science, it must be realized that one has to treat animals in herds or *en masse*. For the treatment of animals the supply of the vast array of antibiotics which are still in their experimental stage, is neither adequate nor cheap enough. Thus a veterinary clinician has to choose a therapeutic or preventive agent which must be safe, effective and cheap, and nothing satisfies these conditions as well as sera and vaccines.

In animal disease control work, the main object is to find out the means of preventing diseases. It is economically unsound to cure diseased animals, as individual cures might cost more than the patient is worth to the farmer. Hence prevention rather than cure is the basis of veterinary practice. This fact emphasizes the justification for the origin and introduction of modern immunology, the technique of which has been proved by universal experience in veterinary and human medicine to be a great advance on the indigenous systems of medicine whether Yunani or Ayurvedic. The scope of these old systems, however, will still remain in certain spheres, particularly in regard to the benefit of certain proved preparations for which investigation is being increasingly carried out, and no doubt some of them will be utilized in animal husbandry. It is important to clearly appreciate the scope of each system as otherwise, misdirected attempts to utilize indigenous systems in the control of outbreaks of epizootic diseases such as rinderpest, foot-and-mouth disease, etc. are likely to result in the wastage of efforts and resources. Therefore a supply of reliable veterinary biologicals is essential for the needs of the country.

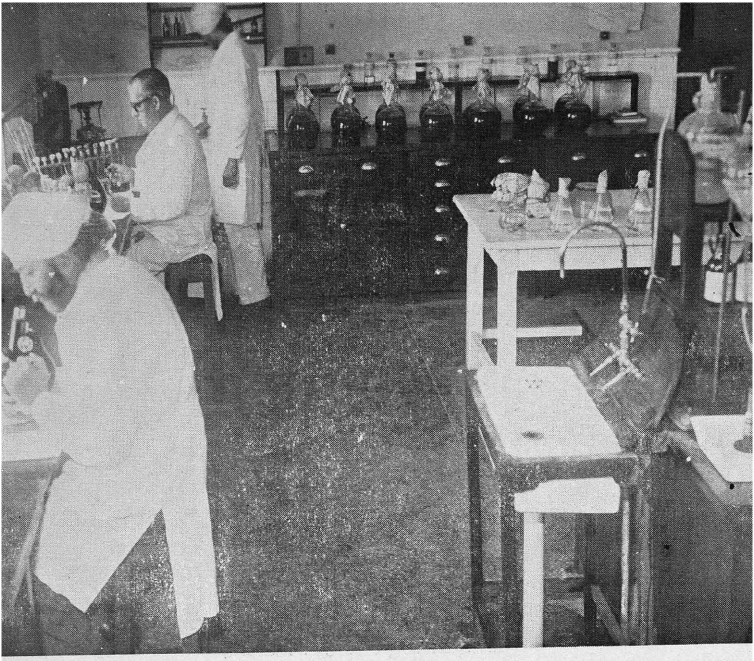
The Biological Products Section came into existence with the appointment of the Imperial Bacteriologist with the object of studying disease and the biological measures of control. Outbreaks of epizootics stalked the country and losses were appalling. After three years of work it was decided to lay greater emphasis on the production of biologics against rinderpest than for other diseases. For this reason the work was shifted to the cool climate and isolation of Mukteswar as it was thought impracticable to work with such diseases in the plains, and particularly as refrigeration facilities were not available then. By 1901, six different biologics, some of them prepared from the local hill bulls, had been evolved and issues were started. At this time, Kurgaina site near Bareilly was acquired for the testing of products under plains conditions. Later, however, it was found that sera could be produced from cattle and buffaloes in the plains more economically. A substantial portion of the manufacture was then shifted to Kurgaina, but for storage the pro-

BALWANT SINGH is Officer-in-Charge, Biological Products Section.



Biological Products Section Laboratory

PLATE 9



Inside a laboratory of the Biological Products Section

PLATE 10

ducts had to be sent to Mukteswar hills, about 100 miles away, even though the method of communication in the hills was not convenient. Kurgaina site was small and very close to a much frequented path and the risk of contagious diseases being introduced into the station or spreading out to passing animals was found to be great. An alternative extensive site at Izatnagar on the northern outskirts of Bareilly was then purchased. The first world war broke out and development on the Izatnagar site could not be made until 1923, when Kurgaina site was sold off and the Izatnagar substation was placed under the charge of Mr. J. R. Haddow, the third Veterinary Research Officer. In 1930, the name of the Station was changed to Imperial Veterinary Serum Institute and the Officer-in-Charge was named Deputy Director. This office was successively held by Messrs. Malkani, D'Costa and Hassan. Since 1936, the Institute has been renamed as the Biological Products Section of the Imperial Veterinary Research Institute and the designation of the head to Officer-in-Charge. The present incumbent took over on 15 August, 1947.

Achievements

The products taken in hand in the beginning were anti-rinderpest serum, anti-haemorrhagic septicaemia serum, anti-anthrax serum, anti-blackquarter serum and blackquarter aggressin. Then in 1940, the manufacture of haemorrhagic septicaemia vaccine, blackquarter vaccine, fowl-pox vaccine, fowl cholera serum and fowl cholera vaccine was started. At present the Section is manufacturing all the above biological products except the blackquarter aggressin. Some products manufactured at Mukteswar are stored by this Section for quicker supply to the customers. Prior to 1933, the methods and equipment for the processing of sera were not very perfect. Thus between 1933-35 newer methods were elaborated and improved designs of equipments were made to perfect the work. In addition, researches were carried out to find out the value of calfhood vaccinations against rinderpest and a detailed and illuminative work on blood-grouping in animals was done.

The Section has been supplying expeditiously biological products according to the demands of the country. It has been able to meet unforeseen heavy demands due to the emergencies like those created by the last war and the partition of the country without impairing the normal supply to the usual customers. These additional and often unexpected responsibilities were fulfilled with the minimum additional expense to the Government. It is gratifying to note that this Section has also been able to meet the demand for various biological products in fairly large quantities from various foreign countries like, Afghanistan, Iraq, Iran, Egypt, Ceylon, Siam, Malaya and China as well (Plate 11). In 1949-50, the Section issued 45,86,364 doses of vaccine, as compared to 33,59,725 in 1937-38, 75,86,151 in 1929-30, and 35,16,421 in 1920-21. The number of doses issued in 1949-50 becomes more significant when it is remembered that the partition of the country has robbed the Institute of potential customers and that the organization of sera and vaccine production centres in certain States developed through the help and training given by this Institute has lessened the demand from veterinary departments of these States for certain products. Yet the demands for products have not undergone any appreciable reduction. This is due to the fact that greater emphasis is being laid by the authorities on control measures.

Cost and commercial basis

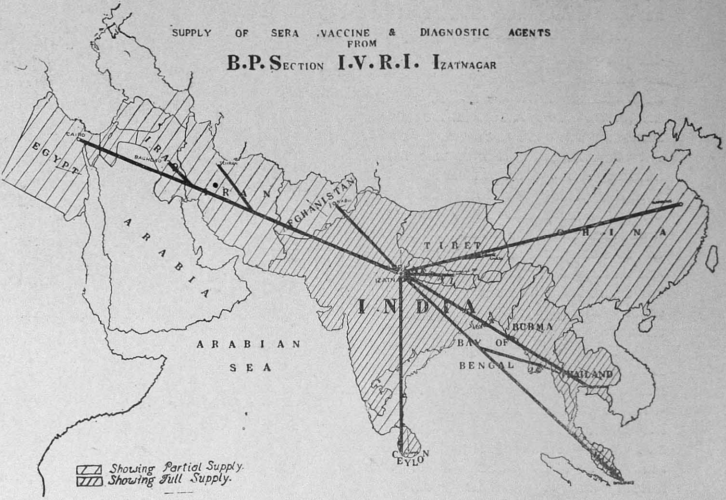
Prior to 1911, no charges were made to the provincial and military authorities for the biologics issued to them. From that period, a small charge of annas two was made for every dose of anti-rinderpest serum issued to the civil authorities only. In 1917-18 a charge was introduced upon

all routine products of the Institute supplied to customers. This procedure helped to bring over three lakhs of rupees every year. The Indian Retrenchment Committee recommended in 1922-23 that the Institute should be placed on a self-supporting basis as they did not think there was any justification for its products being sold at uneconomic prices. The prices of the products were therefore increased with the result that from 1925-26 for some years the receipts exceeded the total expenditure. The Royal Commission on Agriculture observed, however in 1927 that the self-supporting basis though admirable for times of great financial stringency, was not suitable for permanent development. It considered that expenditure on research and manufacturing operations should be distinguished as fully as possible. The Institute on its factory side should be regarded as an All-India affair, and maintained to supply the States with sera and vaccines at cost price. Accordingly, since 1930 the accounts of the Biological Products Section have been kept separately, and a system of cost and commercial accounts was introduced. Since then the Section is being run on a no-profit basis.

The various epizootic diseases among animals in India have been taking a heavy toll of livestock annually. With the evolution of various biological products and their judicious application, the enormous losses due to various contagious and infectious diseases have been reduced considerably. Assuming that even one per cent of the products issued by the Section every year had been effective in checking the disease, the total benefit accruing therefrom amounts annually to about two and a half crores of rupees—a sum far in excess of the total amount spent by the Government on the Section since its inception. Despite the phenomenal drop in the death rate among the livestock in India, during the last sixty years the losses due to preventible epizootics still run to about a million a year. The means to avoid these losses are available to the Nation through this Section. With proper facilities and concerted efforts these diseases can be stamped out. The economic gain to the country through such an endeavour will be immense and will enable India to reorganize her livestock industry.

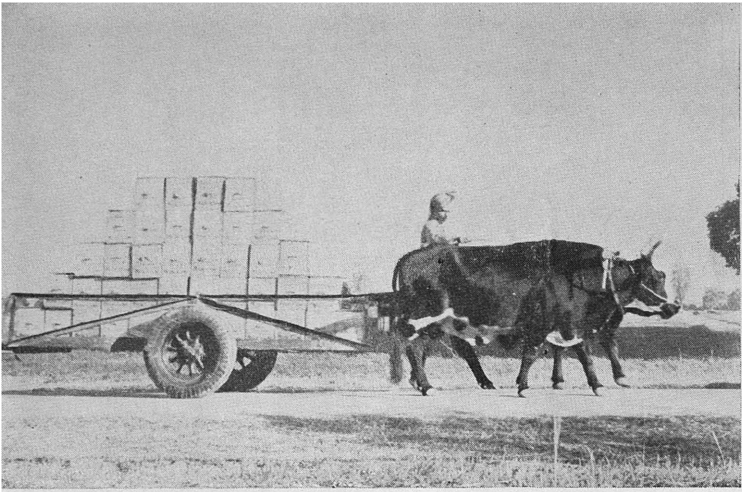
At present the routine manufacture of some biological products in a few States in India is being carried out. It is true that such a policy is satisfactory so far as the easy availability of certain well perfected vaccines like 'goat tissue virus' and 'Ranikhet disease vaccine' is concerned, but it would be economically and otherwise unsound to aim at the production of all types of vaccines and sera in one and all of the States. The reasons are obvious. The extremely complicated task of the preparation of biologicals and the guaranteed quality of issues is no easy matter. In mass production, the biologics are cheaper and standardization is easier. All this can only be carried out by a team of well experienced research workers. This central Institute being a pioneer in this line can be left to supply the standardized products to whole of the country. The standardization of the biological products is an absolute necessity and should be enforced by an Act of the Parliament. This work can very fruitfully be taken up by this Section where the products are standardized at present. Until the time a modern centre for the standardization of veterinary products is established, products manufactured at different places will not be of equal dependability. Any move to set up a multitude of production centres will not only be waste of money but of talent as well.

It may be added here that under the Drugs Act 'drugs' include biologicals intended solely for the treatment of animals. At present veterinary biologicals are not subject to licensing, standards of quality, etc. under the Act, contrary to what obtains in the medical field. Central Re-



Map showing distribution of biologicals from Izatnagar to different foreign countries

PLATE 11



Despatch of biologicals for the field

PLATE 12

search Institute, Kasauli, assays such products for human use on behalf of the Government of India. Similar arrangements in respect of veterinary preparations are required at this Institute.

Thus it will be apparent that during the last fifty years the Biological Products Section has been supplying India and her neighbouring countries the aid for livestock conservation. The manufacture of sera and vaccines in huge quantities has been carried on efficiently and the standard has been maintained in spite of lack of laboratory space, apparatus, equipment and shortages of staff. The expansion which is so legitimate for such a highly profitable concern has not yet been given effect to due to financial stringency. The sanctioned scheme for the building of a more spacious laboratory and for purchasing modern equipment in the place of worn out machinery in the Section have not yet been given effect to. These schemes should be implemented as early as possible if the Section and the Institute are to play their proper role for the betterment of the country's livestock which brooks no delay.

PARASITOLOGY SECTION

By H. N. RAY

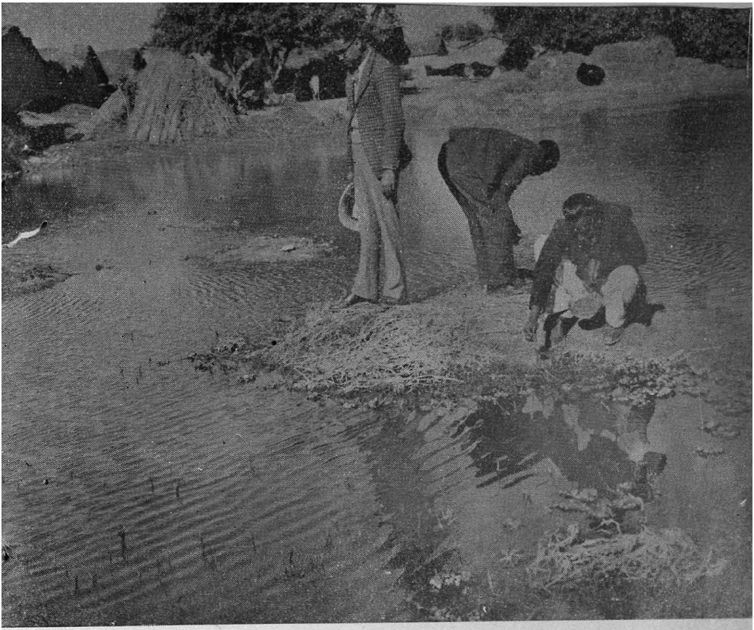
THE Section of Parasitology has developed slowly in consequence of a gradual realization of the incidence and importance of parasitic infections among the Indian livestock. In the nineties, the problem of high incidence of surra and filariasis in horses had attracted attention and the resuscitation of dormant coccidia in rinderpest had been observed. The possible role of insects in the transmission of rinderpest had been suggested. While research work on the causation and control of epizootic diseases progressed, the data on parasitic diseases which became available by 1923 warranted the creation of two posts of Assistant Research Officers—Protozoologist and Helminthologist—at the Institute, which were, however, sanctioned three years later. In view of the necessity of a close study of theileriasis in imported bulls and other protozoal conditions in domesticated animals, a Systematic Protozoologist was appointed in 1936, the designation of Assistant Research Officer (Protozoology) being changed to Entomologist. With the organization of the technical work of the Institute into various Sections, a section of protozoology, comprising of protozoology and entomology was created in 1931 with the Director in charge of it. The Section was properly organized with the appointment of Dr S. Datta in 1937 to the post of Veterinary Research Officer (Protozoology). Two years later it was named Veterinary Zoology Section, and the subsection of helminthology in the section of pathology was transferred to it. In 1948, the Section was renamed as the section of parasitology. Dr S. Datta was succeeded by Dr G. D. Bhalerao as Officer-in-Charge of the Section, which is at present in the charge of Dr H. N. Ray.

H N. RAY is Officer-in-Charge, Parasitology Section.

The main function of the Section is to study the manifold problems of parasitic infections in animals and to devise measures for the prevention of losses due to them. In addition, the Section takes its full share of the routine activities of the Institute in the diagnosis of parasites from all over India and sometimes from the neighbouring countries, giving expert advice on problems of parasite control, holding post-graduate classes and imparting of advanced training to officers of the States and military departments and university students The work of the Section is carried on in three subsections—protozoology, entomology and helminthology, the achievements of which are briefly mentioned below:

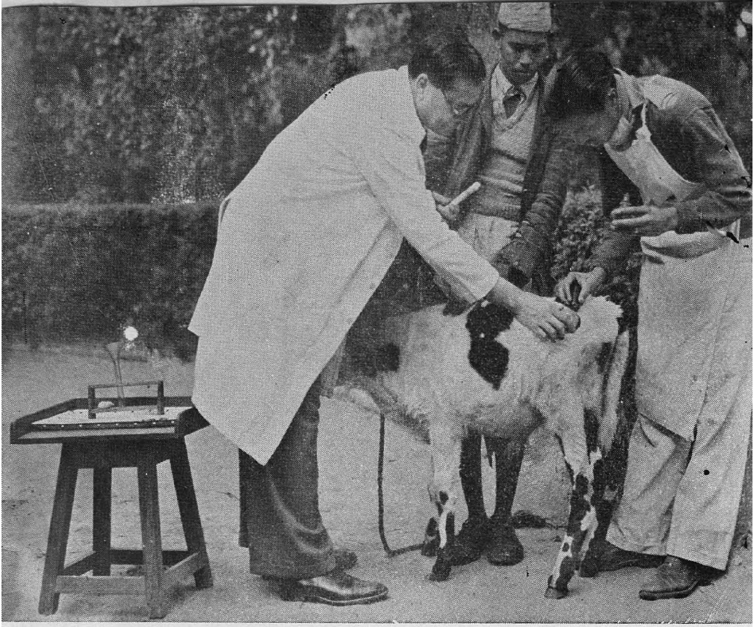
Protozoology

The great majority of the protozoa (unicellular smallest animals) are free living and harmless. A large number live normally in the digestive tracts of animals, specially herbivorous, exerting no harmful effects but helping the host in digestion. A small number of these, however, which lives as parasites is responsible for some of the most important diseases of men and animals. All species of domesticated animals are susceptible to infection, and in view of the large number of hosts and diversity of these infecting parasites and the prevalence of vectors under tropical conditions, protozoology in Indian animals is much more important and wider in scope than in human medicine. Transmission of infection is not brought about by direct contact but by an intermediate host or vector, usually a biting fly or tick, the diseases being restricted to places suitable for the survival and multiplication of their vectors. In the case of amoebiasis and



Control of surra—survey of Tobanus files in a village

PLATE 13



Theileriasis in cattle—experimental tick feeding on a calf

PLATE 14

coccidriosis, infection is caused by the ingestion of resistant infective stage of the parasites.

Preventive treatment and control measures are based on a knowledge of three main factors, viz. biology of the protozoa, its vector and the reaction of the animal to the parasite. Serum or vaccine therapy are of little or no value in protozoan infections. Where therapeutic agents have failed to check the disease, control measures based upon the natural history of the disease have been evolved. The recovery of an animal from a protozoan infection does not necessarily mean complete disappearance of the parasite from the animal's system because many animals exhibit a tolerance to the parasite for a fairly long time, often throughout life. These carriers serve as reservoirs and are potential sources of danger to healthy animals should the necessary vectors be forthcoming.

Surra: In India surra occurs in several species of animals, elephants, camels, horses, mules, ruminants and dogs. Its symptoms and other clinical manifestations were noticed as early as 700 B.C. but in 1880 for the first time its causal agent was shown to be a protozoa, *Trypanosoma evansi*. This was one of the main items of research when the Institute was founded in 1889 and has remained so since. Data available only for the last two years show that the monetary loss due to deaths caused by surra only, amounts to Rupees one and a half lakh annually, besides the much greater loss due to the decrease in the working capacity of draft animals and in the milk yield of milch animals.

Up to the end of the first great war, attention was focussed on finding some treatment for surra and several drugs were tested. But with the introduction of 'Naganol' (Bayer 205) experiments with arsenical and antimonial drugs were abandoned and the efficacy of the new preparation was established. During the second world war 'Naganol' was replaced by an identical British preparation 'Antrypol', which still holds the ground, but may be replaced by 'Antrycide'.

Glanders and Farcy Act has helped in stamping out from India Dourine, another form of trypanosomiasis in horses, but this has not been possible in surra since cattle and buffaloes act as reservoirs of infection and perpetuate and disseminate the disease. The problem of diagnosing latent cases of surra remained baffling but recently an allergic test has been evolved at the Institute. A chemical test has also been evolved here. It has been found that pantothenic acid (Vitamin B complex) given in the diet inhibits the rate of multiplication of these parasites in rats. Whether a similar factor in the 'carrier' ruminants is responsible for chronicity leading to autosterilization has yet to be investigated. An interesting mode of reproduction (syngamy) in a species of trypansome has been observed recently.

Babesiasis: Red water fever in ruminants and horses is produced by host specific protozoa of the genus *Babesia*. A new species has been discovered affecting the blood of the Indian sheep. As a result of detailed studies on the morphology, symptomatology, pathogenicity and chemotherapy of *B. gibsoni* infection in dogs, a new genus *Pattonella* has been created for the parasite. *Aegyptionella pullorum* infection in fowls has been found to occur in India and to cause mortality at times. This infection has been shown experimentally as being transmissible through a tick.

Theileriasis: This infection in cattle is fairly common in India being responsible for considerable economic loss. In the absence of any satisfactory treatment, control through the eradication of its arthropod vector is aimed at. As a result of several years' investigations at the Institute it has been found that the causative parasite is transmitted by a tick and that the progeny of the infected tick are also capable of transmitting the infection but only in their adult stages and not in the larval stages.

Coccidiosis: Ruminants, poultry and rabbits suffer considerably from this infection. In poultry, the disease is next to Ranikhet disease in virulence. The parasites are host specific and several species of new or unrecorded coccidia have been found affecting Indian hosts. The resuscitation of coccidia in cattle infected with intercurrent diseases has been a serious problem. Investigations are in progress on the incidence of coccidiosis in sheep and goat breeding farms in India, on the predisposing climatic factors and on breed susceptibilities.

Studies on other protozoal diseases: In the studies on malarial parasites of the flying squirrel and the Himalayan *langur,* stages of exoerythrocytic schizogony in the liver have been noticed, which has bearing on similar studies on human malaria. Among the protozoal diseases under study may be mentioned amoebiasis in ruminants and *langurs,* trichomoniasis in pigeons and young poultry, bartonellosis and toxoplasmosis in dogs and rickettsiosis in sheep and cattle. The organisms termed encephalitozoan produce encephalitis and nephritis in rodents. The organism recovered from a rabbit is being studied to see if spontaneous deaths among laboratory animals may be due to this parasite.

Technique: For a rapid diagnosis of intestinal flagellates a simple and useful technique has been evolved. Ticks are known to act as vectors in several protozoal diseases. In order to follow the development of the parasites through the various organs of the vector, serial sections of the latter have to be prepared. This was rather difficult till a technique for cutting sections of ticks was evolved at the Institute. A simple method of demonstrating the presence of protozoa in intact salivary glands of ticks perfected recently obviates the necessity of cutting serial sections of ticks for this purpose.

Entomology

Veterinary entomology is concerned with the study of arthropod (insects, ticks, mites, etc.) pests of domestic animals, their parasites and predators, the damage caused by them to animals and animal products, the transmission of animal diseases through them and the measures for the control of these pests.

Considerable mortality amongst cattle and other livestock in India are due to diseases transmitted by arthropods. Infections by these parasites result in a variety of damages, namely defective growth, decreased vigour and lowered productive capacity. Considering the country's huge livestock population the damages due to arthropods are enormous and the cost runs into many crores of rupees annually. According to the present market rates it has been computed that the value of hides and skins in the Indian Union is depreciated as a result of damage due to warble flies and ticks alone to the extent of Rupees seventy five lakh per year.

Transmission of animal diseases through insect vectors: The study of transmission of diseases of animals through arthropods has been one of the main items of investigation at the Institute. Important diseases studied so far are surra, rinderpest, anthrax, haemorrhagic septicaemia, theileriasis, fowl spirochaetosis and hump sore. Leonard Rogers working at this Institute was the first to test the possibility of tabanus flies transmitting surra, and subsequent work at this Institute has confirmed it. Experimental transmission of this disease by *Haematopinus tuberculatus* and Musca (mostly nebulo) has also been achieved. *Pasteurella avicida,* the causal organism of chicken cholera, has been shown to be transmitted through *Argas persicus* ticks. A thorough account of the mechanism of tick transmission of fowl spirochaetosis has been given. The tick transmission of *Spirochaeta cobayae,* the causal organism of relapsing fever of guinea pigs, has been established.

It has been shown that healthy rabbits can contract haemorrhagic septicaemia

through *Ctenocephalus felis*. Transmission of anthrax through *Musca domestica, Musca nebulo, Ctenocephalus felis* and *Hyalomma aegyptium,* has been shown to be possible. The period for which anthrax spore can survive in the gut of earthworms and of various arthropods has been determined.

The possibility of arthropod transmission of rinderpest has been investigated. The disease has been transmitted successfully through *Tabanus orientis* and *Stomoxys calcitrans* after a period of incubation of the flies at a temperature of 22°C. The problem of transmission of fowl malaria and fowl aegyptionella has been studied. The transmission of causative organism of malaria—*Plasmodium heroni*—has also been studied.

Survey of insect and acarid vectors of livestock in India: The distribution of the arthropod vectors of many important diseases of livestock is being studied with a view to controlling diseases in particular localities. The surveys carried out have revealed several pests as having wider distribution in India than previously believed. The distribution of ox and goat warble flies and species of cattle ticks and Tabanid flies has been mapped. The discovery of the occurrence of the spinose ear tick in India is of special interest, for this serious pest of livestock was previously known to occur in America and South Africa only. The presence of the air sac mite in fowl has been reported from Mukteswar and Kashmir. A survey of Tabanus flies in certain villages near the Institute is also being conducted.

Parasites of insect pests: The tick parasite, *Hunterellus hookeri,* occurs in Dharwar in the Bombay State. The life history and bionomics of this parasite have been studied. Attempts are being made to artificially breed this fly on a large-scale with a view to eradicating susceptible ticks.

Control of insects and ticks: Control of arthropods by insecticides, such as the DDT, benzene hexachloride, derris powder, tobacco lime mixture, pyrethrum and several other preparations and also by biological methods has been under study for several years. In the control of warble fly successful results were obtained in the field in the Punjab by periodically singeing the hairs on the legs of cattle during its egg laying season. Considerable amount of work has been done in the control of ectoparasites of cattle, sheep, goat and poultry.

Bionomics, life history and anatomical studies: The bionomics and life histories of a number of ticks, warble flies and other arthropods of veterinary importance have been worked out under Indian conditions. The incidence of several of these arthropods and the behaviour of myiasis producing flies have been investigated at Izatnagar. The behaviour of mange mites in domestic animals has also been followed.

A significant contribution has been the discovery of an undescribed organ in the mouth-parts of ticks which is considered to be homologous with the hypopharynx of blood-sucking diptera. A new apparatus for measuring the respiratory exchanges in the *Culicidae* has been discovered. The oxygen-hunger in the case of larva of *Culex microannulatus* was much greater than in the pupa and that a meal of blood is not essential for the maturity of their ova and also that the act of feeding is not influenced by a thermal stimulus.

An appreciable increase in milk yield has been noticed as a result of controlling flies and ticks of cows. From a study on 95 milch cows it has been found that as much as 22 per cent of the milk yield may be lost due to these parasites.

Systematic veterinary entomology: Considerable amount of systematic work has been done on arthropods of veterinary importance, of which large numbers occur in India. A comprehensive and very useful monograph on veterinary entomology in India has been prepared by Sen and Fletcher.

Miscellaneous items: Control of mala-

ria mosquitoes and housefly is being carried out at Izatnagar for the last few years. Mention may be made here of an advancement in the technique of feeding ticks on domestic animals by a special cup by which every single tick can be recovered after the feed.

Helminthology

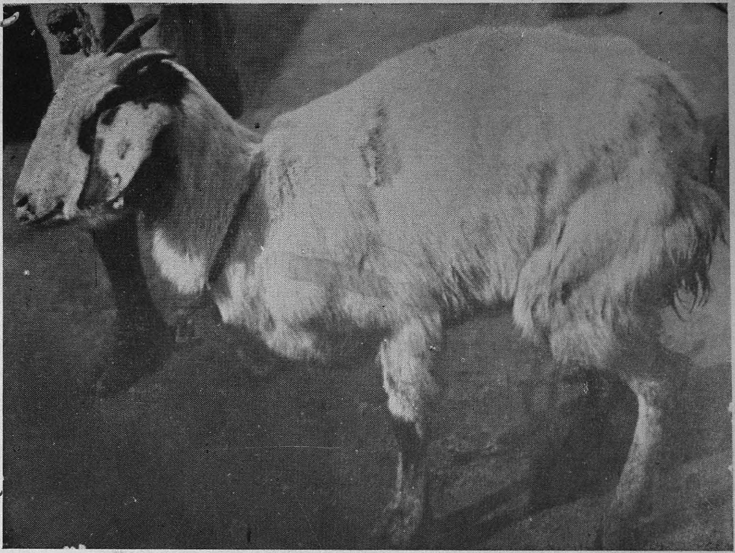
Veterinary helminthology aims at the conservation of animal health by attempting the control of parasitic worms of livestock. Helminths differ widely in their structure, biology, habitat and injuriousness. Different methods are used for the treatment of affected animals and for the control of these parasites which may be flukes, tapeworms, roundworms or thorny-headed worms. Barring a small group of flukes, they are all internal parasites and cause damage to the host through one or more of the following ways: depriving the host of its food; feeding on the tissues of the host; mechanically causing irritation, injury, obstruction or pressure; causing abrasions through which secondary infection may take place; formation of nodules or tumours and elaboration of substances injurious to the host.

Importance of helminths: A great majority of the domesticated animals in India is infected clinically or sub-clinically with worms. The routine examination at the Institute over a number of years of pathological material collected from domesticated animals from different parts of the country revealed more than half of it as of helminthic origin. This high incidence is only natural, because of the large animal population, gradually diminishing pastures, and consequent over-stocking accentuated by the existing favourable topographical and climatic conditions for the multiplication and spread of worms, aided by poor nutrition of animals, ignorance of livestock owners and the absence of animal hygiene measures. Species of worms which affect animals of economic importance are numerous, and a valuable monograph entitled Helminth parasites of Domesticated Animals in India was published by Bhalerao (1934) of which a revised and enlarged edition is under preparation.

Worms exert a highly adverse influence on the animal wealth of the country. Their economic significance may be appreciated from their constant association with a number of disease conditions, the retarded growth of affected animals and chronic ill-health, reduced usefulness, high mortality of livestock and the recurrent losses in widespread and numerous endemic areas in the country. Even so, their role in affecting the health and productiveness of livestock is not often recognized because the symptoms of helminthiasis may not be sufficiently spectacular and may be often masked by superimposed infections.

Studies on incidence, morphology and classification of helminths: A survey of helminths affecting the animals is necessary before the priority for investigations into the losses can be determined. Extensive surveys thus carried out on the incidence of worm infection in ruminants and poultry in several States and some selected villages near the Institute, have revealed high incidence of worms and some previously unrecorded species have also been met with. Larval flukes found in snails in some States and in Bareilly have been surveyed. A number of food fishes and some wild animals also have been examined, either for their economic importance or because they may act as 'carriers' of parasites of domesticated animals and of man. With the material thus available, studies have been made on the occurrence, morphology and classification of several hundreds of species of worms of ruminants, horses, pigs, dogs, cats, poultry, fishes, snails and some wild animals.

Studies on life histories: Helminths do not multiply within the body of their final host and every adult worm found inside an animal must have entered as infective larva from outside. The developmental



Helminthic gastroenteritis in a goat

PLATE 15

stages which leave the final host are not immediately infective and for their development to the infective stage a definite period of time and a set of conditions is necessary. Thus a sure method of the prevention of infection lies in interrupting the life cycle of the parasite at some convenient stage. The life histories of worms, however, differ widely, and a detailed knowledge of them is necessary for formulating effective and rational control measures. The life cycles of some are direct, while in others a large variety of one or more intermediate hosts is necessary for the development of the larvae to the infective stage. For example, the larvae which hatch out from the eggs of liver-flukes penetrate into a particular species of snail in which further larval development takes place before they reach the infective stage. The infective larvae are shed in water by the snail which settle down in the form of small cysts on aquatic vegetation. Animals become infected through the ingestion of these cysts. The life histories of nearly two dozen species of important helminths of domestic animals have been worked out partially or completely. Except a few, all these worms use intermediate hosts for the completion of their life cycles.

Helminthic diseases: As a result of the researches carried out at the Institute, helminthic diseases have been proved to be characterized by widely different manifestations, such as hepatic cirrhosis due to liverflukes in ruminants, dogs and birds, blood fluke eggs in equines and ruminants; snoring disease of cattle due to a blood fluke; fatal diarrhoea in ruminants due to immature amphistomes; verminous pneumonia in ruminants and equines; 'Bursati' and periodic ophthalmia in equines; various types of nodule and tumour formation; localized or generalized filarial dermatitis; 'blood boils' in bovines and equines; oviduct infection with fluke seriously affecting egg-production and a great variety of serious digestive disturbances due to stomach and intestinal worms. The effects of tapeworm infection on young chickens, the pathogenicity of the conical liver-fluke of buffaloes and of whip-worms of sheep and goats have also been studied. Investigations of factors controlling natural, age and acquired resistance of poultry to its common intestinal roundworm, and experiments on the effects of dietetic deficiencies on the natural resistance of birds to this worm have yielded significant results.

Anthelmintics: Experiments have been carried out to test the efficacy of several substances toxic to helminths. Phenothiazine has been found to be effective against intestinal roundworms of poultry and in goats with mixed natural infection of gastrointestinal roundworms. The drug, however, continued to be excreted in the milk, urine and faeces for five to ten days. The comparative value of extracts of two species of male ferns from Kashmere against liver-flukes, round-and tapeworms of ruminants were studied *in vitro*. The mortality due to the large intestinal roundworm among calves is often very heavy. Several drugs like petroleum, ether, turpentine, mustard oil, etc. have been tried in cases of natural infection. Several anthelmintics have also been tested in cases of verminous pneumonia in sheep and goats. The effect of daily oral administrations of dilute solutions of copper sulphate in preventing conical fluke infection in ruminants has been studied.

Control of helminthic infection: Curative treatment of animals by drugs is often not feasible as stockowners are poor, the value of livestock is low, the parasites may be located in inaccessible tissues and organs and due to the absence of immunity in treated or surviving animals after infection. Besides sound hygienic farm practices—various preventive methods—mechanical, chemical as well as biological may be employed. Several of these have been tested as to their applicability under field conditions in India and some new

methods have been evolved.

Though much valuable work has been done and a lot of ground has been covered by bringing out the scope and importance of veterinary parasitology, the entire field of mass application and countrywide campaign of parasitic control awaits to be implemented. Loopholes in knowledge have to be filled up and improvements in control and treatment have to be brought about to reduce wastages and to make the most of available resources. New problems will be arising. The experiences in several foreign countries and in some parts of India suggest that the incidence of parasitic diseases, specially of flukes, will assume enormous proportions when the contemplated major schemes of irrigation are put into operation over large areas. The formulation and methodology of control measures against these parasites will have to be given adequate attention.

ANIMAL NUTRITION RESEARCH SECTION

By N. D. KEHAR

THE vital role played by diet in all successful animal husbandry operations is well recognized. Balanced feeds are essential for the proper maintenance of animals as well as for the production of milk, meat, wool and work. No other country in the world seems to suffer from the inadequacy of feeds more than India, the deficiency of proteins being about 70 per cent, while that of energy producing substances 55 per cent. It is not surprising that our animals are stunted in growth and are the lowest producers in the whole world and fall easy victims to epizootic diseases. Faulty nutrition is the chief cause of the degeneration of our livestock.

Establishment of the Section

The need for a proper study of animal nutrition in this country was felt long ago. As early as 1921, a physiological chemist's section was opened at the Indian Agricultural Research Institute, Pusa, with Dr F. J. Warth, in charge. Two years later the Section was transferred to Bangalore, where it formed one of the two wings of the newly organized Imperial Institute of Animal Husbandry and Dairying. Meanwhile, Sir Frank Ware, the then Director, who looked forward to see the Indian Veterinary Research Institute take its place as the premier research Institute in Asia planned to add to the Institute a separate section of animal nutrition besides those of animal genetics and poultry. The Government of India agreed to transfer the Physiological Chemist's Section at Bangalore to Izatnagar to form the nucleus of the central Animal Nutrition Institute in April, 1936, when on Dr Warth's retirement, Dr K. C. Sen was appointed to hold charge of the Section and the administrative control of the Physiological Chemist's Section was transferred from the Indian Agricultural Research Institute to the Indian Veterinary Research Institute. The actual move of the Section from Bangalore to Izatnagar took place in August, 1936 and from that day the name of this Section was changed into Animal Nutrition Section. The new building of the Section at Izatnagar was opened on 11 March, 1939, by the then Viceroy of India, Marquis of Linlithgow. On 30 August, 1944, Dr K. C. Sen was appointed Director, Indian (then Imperial) Dairy Research Institute and Dr N. D. Kehar has been holding the post of the Officer-in-Charge, Animal Nutrition Section, since that date. The Section is now divided under the following subsections: (1) Physiology (2) Pathology (3) Biochemistry (4) General Analytical Technique and (5) Training.

Besides this, schemes of two to five years' duration under the auspices of Indian Council of Agricultural Research or other bodies are also functioning for the study of specific problems.

Functions and duties

The main function of the Section is the study of nutrition in relation to the maintenance of health, normal growth and productive capacity of animals in India. The Section is also entrusted with the correlation of nutrition work done at the central Institute and the provincial centres and collaborates closely with the Agricultural departments on factors affecting the composition of foodstuffs. It also works in cooperation with other Sections of the Institute on the influence of

N. D. KEHAR is Officer-in-Charge, Animal Nutrition Research Section.

nutrition on susceptibility to diseases and genetical performances, trains young workers in animal nutrition and allied subjects and advises workers from different States on all problems concerning animal nutrition.

Research

Nutritive value of feeding stuffs: Before any concrete proposals can be made about the formulation of economic rations for livestock, it is necessary to know the nutritive values, i.e. how much nutrient is present in all common feeding stuffs and how much of them are digested and then utilized by the animal for maintaining its health and also for all productive purposes. In the programme followed, the chemical composition of the common feeds was determined and then by experiments on animals the amounts of digestible nutrients in these substances were worked out. A vast amount of data have been collected and a rough idea about the nutritive values of all the common feeding stuffs of this country is now available. The work, however, is not complete, as it has been found that the chemical composition and more particularly the digestibility of feeds depends on various factors like soil and weather conditions and the stage of maturity of a fodder. As these conditions vary widely all over India, a more comprehensive study will have to be made in various zones in India in order to get a clear picture. Grasses and plants will also have to be examined at different stages of growth in order to work out the correct time for harvesting these fodders so that the maximum yield of digestible nutrients per acre may be obtained. These aspects are now being studied in collaboration with the Forest Department, Uttar Pradesh and the Agricultural Departments of some other States. It is hoped that with the opening of more regional centres, the tempo of research in this direction will be quickened.

Requirement of different nutrients: The next step was to find out whether the requirement of different nutrients by the Indian farm animals is the same as those recommended for such animals by European or American workers. It has been found in these laboratories that an Indian cattle (1,000 lb. in weight) requires 0.4 lb. of digestible protein for maintenance. Thus the maintenance protein requirement of our cattle is at least 30 per cent less than that advocated by foreign workers. As protein feeds are the costliest items in an animal's ration, the economic value of this finding for stock owners is of practical importance.

Similarly it has been found that on a certain dietary regime, viz. when paddy straw forms the chief roughage, the requirement of calcium, the mineral essential for bone building and adequate milk production, is increased considerably. Similar interrelationships of different feeding stuffs on the metabolic behaviour of various species are under investigation. The various extra nutrient requirements for growth, milk production and work are also being studied and though detailed and thoroughly accurate data about these have not yet been compiled, sufficient work has been completed to get a preliminary idea.

Subsidiary feeds: A calculation of the nutritional needs of our farm animal population when compared with the available digestible nutrients has revealed a great shortage. A rough estimate of this deficiency has already been mentioned above. This condition is further aggravated when famine conditions set in due to drought or floods. An investigation was therefore undertaken to find out new sources of fodder and concentrates—sources which are at present not economically utilized.

This study is far from being simple. Before a substance can be fed to an animal, it must be examined to see whether it is free from toxic principles and contains sufficient nutrients to form an economic feed. Again, their components may not be readily available to the consuming

Animal Nutrition Section Laboratory

PLATE 16

animals or the palatability may be very poor. For this reason, it has to be processed and then blended with other materials to form a balanced feed after which it can be fed to livestock for a sufficiently long period to see whether it adversely affects the health and productivity of animals. When a substance has passed all these careful tests, only then it can be advocated as an animal feed.

Investigations lasting over the last ten years have revealed that a number of substances which are at present being wasted can be utilized as cattle feeds : •

Concentrates: (1) Mango seed kernel, (2) Jaman seed, (3) Panewar (*Cassia tora*) seed, (4) Rain tree fruit pod, (5) Tamarind seed, (6) Babul pods, (7) Mahua flowers, (8) Mahua cake, (9) Tapioca roots, (10) Sunnhemp seed, (11) Fish meals and (12) Entrails.

Roughages : (1) Munj, (2) Kans, (3) Kantiara, (4) Panwar straw, (5) Groundnut husk, (6) Bajra husk, (7) Coffee husk, (8) Sugarcane tops and (9) Bagomolasses (i.e. a mixture of bagasses screenings with molasses).

These researches were extended to find out if shed tree leaves could be utilized as fodder for cattle. Chemical analysis indicated that they were fairly rich in proteins. Successful attempts have been made to feed some of the commonly available leaves to cattle to the extent of 50 per cent of the roughage quota. Their palatability and nutritive value have been increased by ensiling them with berseem. The resultant product was highly palatable and constituted a *maintenance* ration. As a result of these findings a large quantity of the material which is now being wasted, can with advantage be used as cattle feed and the maintenance allowance of concentrate can be saved.

The economic advantages of all these findings are of immense practical value. It has been calculated that if all these subsidiary feeds are properly exploited the animal feeds obtainable from these hitherto untapped sources, which at present go waste, will increase to the extent of about 400 crore maunds per year and the deficiencies of food supply of our animals will be cut down by at least 25 per cent. This will not only ensure a much healthier stock but will also augment their economic contributions.

The Animal Nutrition Committee commended these findings for wide publicity on more than one occasion and the Indian Council of Agricultural Research has approved of a scheme to start a demonstration-cum-exploitation centre in Madhya Pradesh.

Fodder trees: Considerable work has been completed on the palatability and chemical composition of leaves as affected by maturity, soil and climatic conditions. Most of the tree leaves are characterized by their richness in protein and calcium. Though the amount of phosphorous is normal for a roughage, the high percentage of calcium endows a very wide calcium-phosphorus ratio. The digestibility of protein is also not in accordance with the amount shown by chemical analysis. The causes responsible for the poor absorption of proteins are being investigated.

The nutritive values of a large number of tree leaves in different seasons have been examined. Some of these leaves have good feed values and often may be relied upon to provide substantial nourishment to the animals, especially during the periods when better types of roughage are not available.

Improvement of coarse and deleterious fodders: The treatment of certain roughages with chemical agents has been found to enhance their nutritive values. Thus, soaking of straws in dilute alkalis increased the feeding values of these straws by about 50-60 per cent and also was found to remove obnoxious substances like oxalic acid from paddy straw. The occurrence of this acid in paddy straw produced in the animals, fed on this roughage, a condition known as 'alkalosis' which resulted

in the excretion of a large quantity of urine and also a much higher requirement of calcium. Alkali treatment prevented these bad effects of paddy straw and enabled animals to maintain health on a ration containing comparatively much less protein, calcium and phosphorus. Young calves fed on treated paddy straw have shown better growth than those on untreated straw.

Later experiments showed that simple washing of paddy straw with water was also effective in getting rid of a considerable portion of oxalic acid. Likewise the treatment of coarse fodders like *Saccharum munj* (Bhurra or Sarkanda) by dilute alkali has been found to improve texture and palatability.

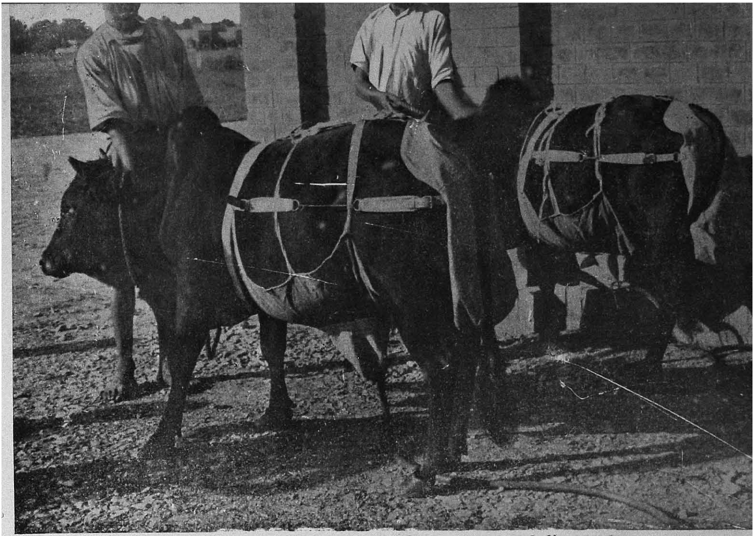
Conservation of fodders: The abundant growth of grasses during the monsoon season if left in the fields and allowed to mature leads to a rapid loss of their nutritive value. To get the maximum benefit, such grasses should be preserved either during the monsoon or immediately after it, and preferably in succulent form, so that they can be fed later when green feeds are not available. Ensiling of these grasses in small pits of the size 8 ft. x 5 ft. x 4 ft. is within the means of small cultivators and solves this problem. Sugarcane tops, green *bhurra,* and some green leaves have been successfully preserved in this way. Silage of paddy straw and green berseem has produced a palatable material and has resulted in the improved digestibility of protein.

Deficiency diseases

Minerals: An animal, getting a ration containing sufficient quantities of proteins, carbohydrates and fats may yet be unhealthy, on account of a deficiency of minerals and vitamins. Of the major elements, calcium and phosphorus are the chief minerals concerned. It has been found that in certain regions of India, phosphorus may be grossly deficient in the fodders available there. This hampers the normal production of bones in the local breeds of animals, with the result that they are stunted and unthrifty. The calcium and phosphorus contents of a large number of fodders have been determined and some idea about the requirements by various species has been obtained.

There are also a number of trace elements, viz. cobalt, copper, manganese, etc. which though present in minute quantities in most feeds, are yet most essential for the proper maintenance of animals. On account of deficiency of minerals in the soil, the plants growing in such soils may be lacking in such essential trace elements. The livestock maintained on such fodders exhibit various pathological symptoms. Introduction of a small supplement of these minerals in the diet had enabled many breeders to raise stock in many parts of the world, where previously all attempts in animal husbandry had failed. The extent of the occurrence of such deficiencies in India is not known. A systematic investigation has, therefore, been undertaken to find out the distribution of trace elements in the various feeds and the variations in their contents as affected by season, maturity of the plant, irrigation, etc. Side by side, the requirement of these elements by different species of animals is being studied. It has been found that the contents of the trace elements in many feeding substances from different parts of India and at certain seasons may fall below the advocated minimum. A countrywide survey is now required to find out the extent to which the health of our animals is being jeopardized due to a suboptimal intake of these health-giving minerals.

Vitamins: As with the minerals, the effect of vitamins, chiefly vitamin A, on the health of animals is well established. A lack of vitamin A in the diet leads to unthriftiness and faulty reproduction in animals. Such animals produce also poor quality milk and butter and may exhibit pathological symptoms like night blind-



Hill bulls fitted up with harness for metabolism trial

Goitre in a still-born kid due to iodine deficiency

PLATE 18

ness, and even total blindness. A large amount of work has been done to find out for different species the optimum requirement of vitamin A or rather its precursor carotene, which is present in all green feeds.

The carotene content of over 100 different grasses, leaves and weeds at different stages of maturity has been examined. The loss on storage as well as during the processes of conservation has been studied. Cooperative work with different States has been carried out to ascertain whether vitamin A deficiency exists among the animals in those places and in positive cases of avitaminosis, advice has been given to correct the rations.

An important finding has been the preparation from vegetable sources, such as radish leaves and green oats, of powders having high vitamin A potency, which can be safely used for both human and animal consumption and may be commercialized.

Effect of climate: The physiological behaviour of different breeds of animals under different climatological conditions is being studied. This is necessary to find out the optimum conditions of temperature and humidity for the maintenance of our animals, so that through inexpensive animal management methods, the productivity of our animals can be maintained unimpaired throughout the whole year.

Toxic plants and minerals: Losses of livestock valued over millions of rupees from the ingestion of toxic plants have often been reported from other countries. No accurate record of such deaths has been maintained in India but as toxic plants occur quite commonly in this country, most deaths of livestock for which causes cannot be ascribed may be due to plant poisoning. Investigations have shown that *Nerium odorum*, Dhatura, *Rhododendron*, *Lantana*, etc. contain toxic principles and that even common fodders like *jowar* and star grass may become poisonous under certain conditions of growth. Methods to get rid of these obnoxious principles from these fodders have been worked out.

It has also been found that water in certain areas does contain abnormal quantities of the element fluorine, and the local cattle show various pathological symptoms like anaemia, faulty bone formation, fractures of long bones and debility. Supplementation of the ration with bonemeal, aluminium sulphate or a mixture of iron, copper and cobalt salts has been found to check the onset of the symptoms and to keep the animals in working condition for longer periods.

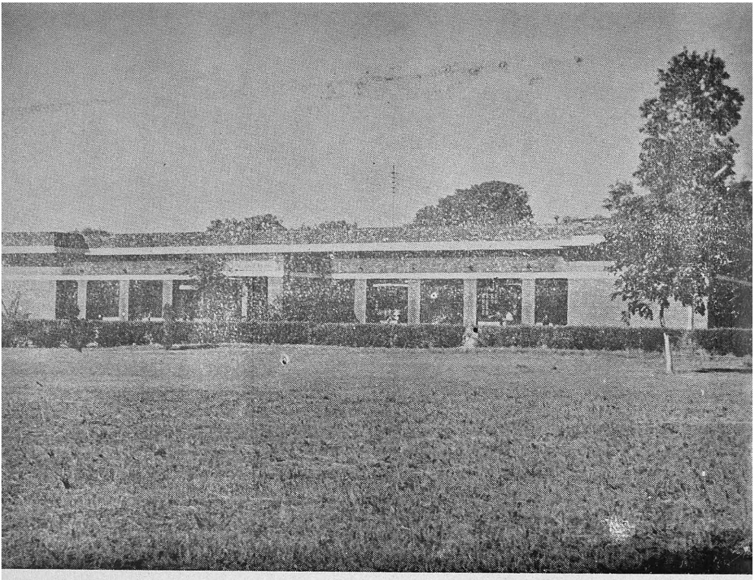
Nutritive value of vanaspati

Due to the shortage of *ghee* in this country, the use of hydrogenated vegetable oils or Vanaspati is becoming more and more popular. Opinion is, however, sharply divided whether the prolonged use of Vanaspati has any harmful effect. A long term investigation into this problem has recently been completed here. It has been found that when basal ration contains superadequate quantities of minerals and vitamins, there is no harm in substituting *ghee* by Vanaspati in a diet. When, however, the diet contains subadequate or just marginal quantities of vitamins and minerals, *ghee* fed animals (rats) were more healthy than rats fed on similar diet but containing Vanaspati in place of *ghee*. This was found due to the fact that in the presence of Vanaspatis, the vitamin and mineral requirements of animals are increased. There was, however, no difference in the nutritive values of Vanaspatis and the common edible oils.

The foregoing narrative gives a brief account of the work which has been brought to a conclusion in this Section. Besides these, investigations on the fat requirement of ruminants, the nutritional requirements of sheep and goats, the composition of blood of animals in health and disease, the differential nutritional

requirements of cattle and buffaloes, the biosynthesis of vitamin C in animals, the comparative nutritive value of 'ghani' and 'expeller' processed oilcake, etc. are in progress.

It will thus be seen that this Section has been engaged for the last 11 years on various studies, which are of great importance not only for the pure scientists, but many of its findings have immense practical value. It has, however, been stressed before that soil and weather conditions vary so widely in different parts of India that it is not possible for a single laboratory to tackle the multifarious problems connected with applied animal nutrition in this country. This point had been realized clearly by the workers in this field, and as early as 1945, a comprehensive plan was presented, which envisaged the opening of five substations in different parts of India. This plan was unanimously adopted at the Animal Husbandry Wing meeting held at Hyderabad and later the Advisory Board of the Indian Council of Agricultural Research also approved of the opening of these substations for the zonal examination of feeds and feeding. Due to financial stringency, however, neither of the plans nor the recommendation of Sir John Russell for adding an Energy Metabolism and Temperature Controlled Wing has been implemented. It is hoped, however, that with the improvement in the financial position of the country, these schemes will be started so that one of the greatest stumbling blocks for the improvement of our animal population will be removed through the proper utlization of all the available feed resources of the country.



Poultry Research Section Building

PLATE 19

POULTRY RESEARCH SECTION

By S. G. IYER

THOUGH India and her surrounding countries are the original home of the ancestors of the domestic fowl it is indeed surprising that little attention has been paid to the development of utility breeds. Until the second world war the Indian poultry industry remained undeveloped and uneconomic owing to the small number and size of eggs produced per bird. Factors responsible for this have been poor stock, prevalence of contagious diseases of poultry, lack of appreciation of the nutritive value of eggs and above all prejudice against the consumption of eggs by a large proportion of Indians.

Poultry and poultry products form highly nutritious supplementary foods in a cereal-rich diet. Milk, an ideal supplementary food, is not available in sufficient quantity and long range projects are necessary to meet the shortage. Poultry, on the other hand, can be multiplied more rapidly and economically. In India, the raising of egg consumption from eight eggs per head per annum to one egg a day will solve many of its food problems. The technical skill called for such an endeavour is available in the country. Poultry keeping is no longer a gamble and involves no big financial commitments.

Although this Institute was founded 60 years ago its activity in the beginning was mainly confined to the mitigation of animal diseases. The Royal Commission on Agriculture in 1927 recommended the establishment of an institute for poultry research. The Government of India accepted this recommendation and the Poultry Research Section at the Indian Veterinary Research Institute, Izatnagar was started from February, 1938. Mr. A. J. MacDonald was the first Officer-in-Charge of the Section till 1946 when he was succeeded by Mr. S. G. Iyer.

S. G. IYER is Officer-in-Charge, Poultry Research Section.

The functions of the Section comprise of fundamental research on poultry diseases, nutrition, physiology, marketing and processing of eggs and poultry, as well as poultry breeding for which there is a well equipped and fairly extensive farm attached to the Institute. The Military Poultry Farm erected adjacent to the Institute Poultry Farm as a wartime measure to increase poultry supplies for the Defence Department, was also taken over by the Institute in December, 1946.

Breeding

Improved Indian fowl: Our village hen is a small bird, producing annually only about 50 small sized eggs. By selective breeding over ten generations, an improved strain has been evolved whose average annual egg production is about 150, while individual hens have laid up to 234 eggs. The size of the egg has also been considerably improved.

It is now necessary to test the performances of the improved fowl under different conditions of soil climate complex, through extension service stations in the various States. If it is finally proved that the improved Indian fowl is suitably acclimatized to withstand the local field conditions, there will be absolutely no need for importing exotic breeds of poultry at fancy prices. The strain evolved is good for both egg and meat production, and is superior in meat qualities to some of the better known imported breeds.

Grading: The grading up of low production stock of Indian fowls by cocks of the foreign breeds, such as White Leg-

horns and Rhode Island Reds, has been proved to be the quickest method of improving an ordinary farm flock as regards egg production and egg size. The eggs produced by the progeny of matings involving the village nondescript hens and purebred cock birds, are significantly larger and the egg production is also nearly doubled.

Pure breeds: Pedigreed strains of exotic breeds of poultry such as White Leghorns, Rhode Island Reds, Black Minorcas, Barred Plymouth Rocks and Australorps are being acclimatized, bred and multiplied in the Institute farms at Izatnagar. Foundation stocks of some of these breeds are being supplied to the various State farms and private poultry breeders every year. This work is one of the most beneficent productive activities of the Institute.

Sex-Linkage: The sexing of day old chicks is an important aspect of economical poultry enterprise. Suitable crosses using Barred Plymouth Rock imported from the U.S.A. and a variety of Indian fowls have been produced in which the sexes of the baby chicks can be accurately determined as the two sexes have different colours. The autosexing of chicks is bound to prove of immense economic value in the poultry industry of the country as has been the case in America and Great Britain. In table poultry trade, this method will help reduce significantly the cost of production.

Village poultry keeping: The egg production records of foreign breeds of poultry under village conditions are very low and bear no comparison with those obtained under recognized good poultry husbandry conditions. The main causes of the low egg production are unsuitable housing, lack of proper feeding and heavy infestation with external parasites.

Inheritance: Experiments on the inheritance of morphological characters such as smut (slaty) under colour in Rhode Island Red fowls and feathers on the shanks and feet of White Leghorns have revealed that these characters which are considered as hereditary defects are not associated with egg laying qualities. The dissemination of this knowledge is very important as valuable birds which are good producers are being killed for the table by fanciers out of ignorance.

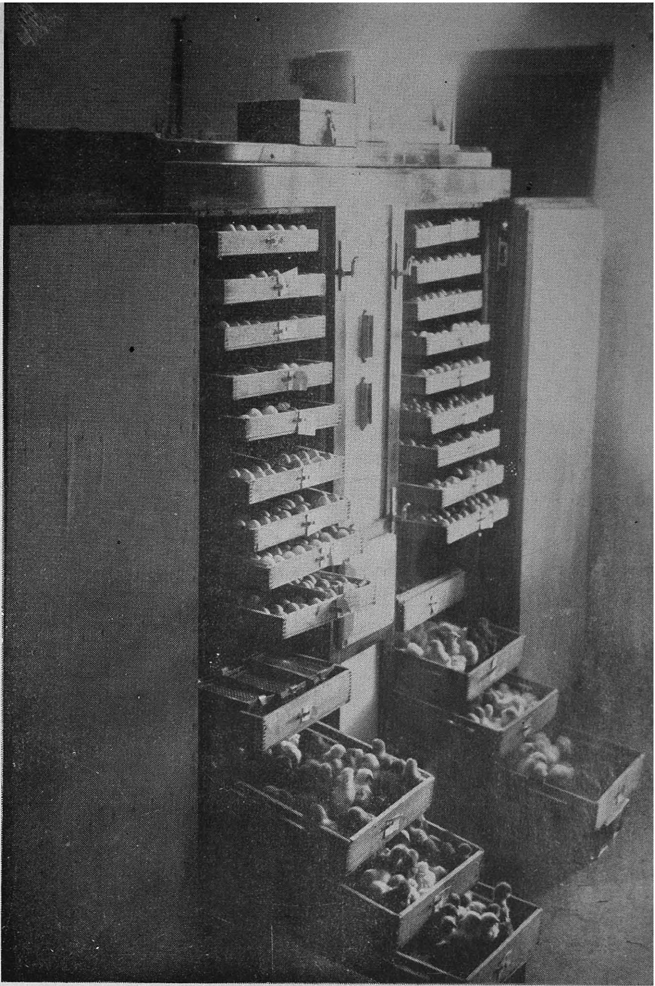
The various factors responsible for the determination of fecundity of birds, early sexual maturity, high rate of production, non-broodiness, lack of winter pause and persistency of production have been studied under Indian conditions.

Nutrition

The nutritional studies on growing chickens and laying hens have been devoted to discover the best and cheapest methods of making good the deficiencies which are found with typical cereal rations. Studies into the improvement of the poor Indian human dietaries through supplements of eggs have also been made.

Indian dietaries and eggs: Investigations have been carried out to determine (a) the number of eggs that should be added to Bengali village diet to produce an optimum growth in rats (b) the supplementary value of eggs and the various common pulses in the village diet. It has been observed that with eggs as the sole supplement to satisfy the necessary requirements for growth and maintenance in children, it would be necessary to consume five eggs daily, an amount which would be too costly for the majority of the Indian population. Substitution of various levels of pulses for the egg supplements demonstrated that from nutritional and economic aspect, a Bengali diet in conjunction with a daily supplement of one egg and soyabeans (66 g.) or green gram (130 g.) or gram (157 g.) proved very satisfactory.

Protein supplement: Controlled experiments on the value of different protein supplements in poultry rations revealed that (a) a cereal ration plus one per cent common salt in conjunction with



Mammoth incubator—egg capacity 4,224; chicks ready for removal

. flock of improved breed of indigenous fowl with brooder house and hopper designed in the Poultry Section for village use

PLATE 21

liberal amounts of green food and limestone, is unsatisfactory both for growth and egg production (b) separated milk is a very valuable protein supplement in poultry rations (c) meat offals as protein supplement give almost as good results as separated milk. As meat offals are usually obtained at a low cost, these should be used more freely in poultry rations (d) soyabean meal and earthnut cake both proved inferior to separated milk or meat offals as protein supplements.

Digestibility co-efficients and biological values: A valuable contribution to the science of poultry nutrition has been made by standardizing a method for determining the digestibility co-efficients and biological values of proteins in poultry rations. The method has proved very useful for the determination of the nutritive value of common Indian feeds for the formulation of economic rations for poultry.

Substitute feeds: The poultry feeds represent the largest single item of expense in the production of poultry and eggs accounting for about 60 per cent of the total cost of production. Attempts have therefore been made to cut down these expenses by introducing suitable supplements which are at present being wasted and can be obtained at a cheaper rate. In this connection the effects of the substitution of cereals by treated cow manure, mango seed kernal and *jaman* seed meal have been studied and have been found to be economical. *Jaman* seed meal has been found to have a depressing effect on egg production but has no deleterious effect on the growth of chickens.

Technology

Egg spoilage: One of the major causes of egg spoilage in India is the development of embryos in fertile eggs especially during the summer season when the eggs become inedible after about 48 hours storage. It is estimated that over a third of the country's output of eggs is lost due to embryo development, staling, breakages, moulds and bacterial contaminations. Methods have been elaborated greatly to minimize these losses. These are: defertilization, limesealing and oil dipping. The defertilization or thermostabilization of eggs is carried out by placing them in warm water bath for 15 to 30 minutes. When properly controlled, this treatment has been found to have great beneficial effects on storage life.

The limesealing is accomplished by soaking the eggs in lime water for about 18 hours prior to preservation. The oiling is accomplished by dipping the eggs for one minute in egg processing oil kept at room temperature. All these methods have great potentialities and should be extended to large cities by opening suitable grading stations under expert supervision.

Canning: In canning chickens, the use of lacquered cans is preferred as plain tin cans develop dark spots on storage due to the action of sulphur of the meat on the iron of the can. Investigations have also shown that the addition of common salt greatly helps in the development of metallic taste even in the contents of the lacquered cans, especially when the lacquering is not perfect. The addition of salt is, therefore, not recommended in canning chickens. The common salt and spices may therefore be added before serving on table.

Pathology

Ranikhet disease: The control of Ranikhet disease of fowls by a cheap and safe vaccine has been achieved. The vaccination has no adverse effect on either growth rate or egg production.

Salmonella: The Salmonella infections of poultry are highly destructive to baby chick trade in all countries where poultry farming is a specialized occupation. India was so long free from this disease. Outbreaks, however, have been recorded recently in widely separated areas confined to specialized farms causing chick mortality, reduced egg production and in some

cases deaths among mature stock. In each case the spread of the disease has been controlled and eradication of the infection made possible through improved blood tests.

Fowl cholera: The existence of carriers responsible for perpetuation of the disease from one season to another has been brought to light. The preparation of more satisfactory vaccines is in progress.

Avian Leucosis complex: This is a disease almost new to India and its incidence in widely separated areas of the Union has been recorded. The nature of the causal agent has been shown to be a filterable fraction (virus) capable of experimental transmission in susceptible birds. Valuable laying fowls are sometimes the victim of this malady and therefore intensive research into the problem is being carried out.

Fowl pox: In recent years numerous reports on the incidence of fowl pox have been received and in chicks the mortality is very severe. An English strain of pigeon pox virus has been used as a vaccine with satisfactory results. The suitable age for vaccination has been found to be six weeks and above.

Avian Malaria: The first field case of *Plasmodium gallinaceum* was recorded in India in 1949 by this Section. The disease has been reproduced experimentally by blood inoculations and the chemotherapy and various other aspects of the infection are under investigation.

Deficiencies: The presence of vitamin A deficiency in chickens at several large farms was confirmed by assaying the vitamin A content of livers from birds showing typical lesions of the condition in the eyes and throat. Further spread of the trouble was checked by supplementing the rations with greens, or shark liver oil.

Ticks: *Argas persicus* is quite common in houses wherever poultry is kept, and is highly destructive to poultry flocks. Application of a 10 per cent aqueous suspension of Derris root powder on the infested parts of the body, kills all the ticks. Recent trials with Gammexene by dust method or by dipping the affected birds in 2.5 per cent solution proved effective.

ANIMAL GENETICS SECTION

By P. BHATTACHARYA

THE science of animal genetics is concerned with the breeding of animals and can play a very significant role in improving the quality and productivity of our animals. It shows us the means by which one can transfer desired characters such as high milk yield, high egg production, early maturity, superior wool quality, better draughtability, resistance to diseases, etc., from selected parents to their progeny and so develop the existing ones or evolve newer varieties or breeds possessing a combination of a number of desired qualities.

The best breeds of world livestock evolved in Great Britain were developed long before anything was known about the scientific principles of breeding; but that was possible due to the practices adopted by the 'improvers', being per chance in accord with the laws governing the science of genetics. It will have to be remembered that there must have been countless failures against the few successes in deliberate fashioning of new breeds by the old practical breeders. A correct grasp of the science of genetics enables the modern stock breeder to discard all unessential steps in his operations and to proceed to his goal more confidently and directly. By adopting scientific breeding policy, many countries in recent years have created useful varieties of animals adapted to the local conditions and of different types of productivity. The scope of practical genetics has been enlarged greatly by the application of relatively modern developments like endocrinology, physiology of reproduction, artificial insemination, etc. which now form branches of the major science. Rich harvest in the economic field has been reaped by many countries by the judicious exploitation of these branches.

P. BHATTACHARYA is Officer-in Charge, Animal Genetics Section.

India possesses an immense wealth of livestock. The enormity of size and the diversity of variants are the characteristic features of our livestock population. The productive capacity of the livestock, however, is appallingly poor. There exist, therefore, inexhaustible possibilities for further development by harnessing the knowledge of modern science of genetics in livestock breeding.

The existence of a large number of Government livestock farms offers unparalleled opportunities to trained animal geneticists for fruitful experimentation. It is, therefore, surprising that this important science has been sadly neglected in India, until the creation of the Animal Genetics Section at this Institute.

Development of the Section

With a view to making the central organization at Izatnagar complete for the development of the main subjects of animal husbandry, by providing facilities for the investigation of fundamental problems connected with the subjects of veterinary medicine, animal nutrition and animal genetics to proceed side by side the proposal for the establishment of Animal Genetics Section at this Institute for researches in animal genetics and allied sciences was at first made in 1936 by Sir Frank Ware, the then Director of the Institute. Due to financial stringency and lack of trained personnel at first, and later due to the difficulties created by the war, it was not possible to give the proposal any concrete shape until 14 February, 1944, when the nucleus of the Animal Genetics Section was started with the creation of the post of Research Officer (Genetics) with a

skeleton staff. Dr P. Bhattacharya was the first incumbent of the post of Research Officer. With the upgrading of this post to that of the Officer-in-Charge, Animal Genetics Section in July, 1945, the Section was raised to the status of a full fledged one. From its very inception the Section had to pass through many adverse conditions with regard to trained personnel, laboratory accommodation, adequate apparatus and equipment, and experimental animals due to the abnormal conditions created by the second world war and the post-war financial difficulties. Even at the present moment the Section is housed in a small block of rooms belonging to the Animal Nutrition Section, as the construction of the separate building and its experimental stalls has had to be deferred as a measure of economy. In spite of all the obstacles, the Section has made rapid progress in its research activities.

Functions and duties

The main function of the Section is to carry out fundamental and applied researches in animal genetics and allied sciences, with a view to finding out ways and means of improving Indian livestock by scientific methods of breeding. The Section also undertakes biological tests for diagnosing early pregnancy in farm animals as well as in human beings and also analysis of samples of semen for assessing their fertilizing capacity. It also does a considerable amount of advisory work, as the Section is constantly consulted by the Indian Council of Agricultural Research, various State authorities and Army General Headquarters, in initiating new projects in animal husbandry and in supervising the progress of the Indian Council of Agricultural Research schemes operating in the States.

The Section also provides post-graduate research training in different branches of animal genetics and allied sciences. Since 1948, the administrative control of the Estate Section has also been transferred to this Section.

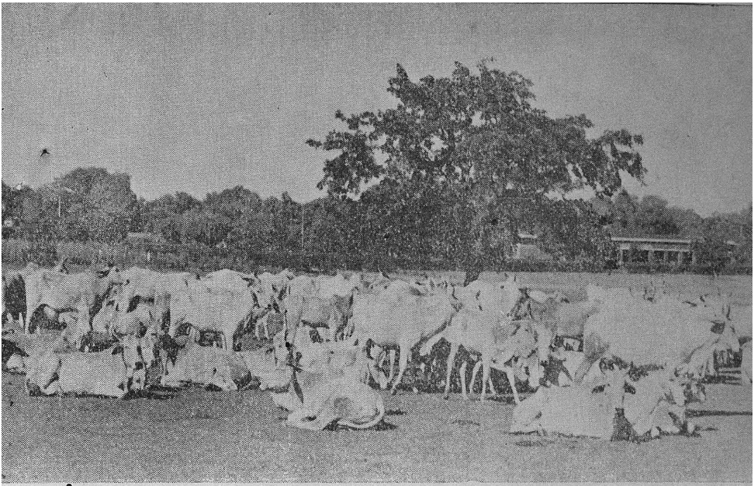
Evolution of new breeds and strains of livestock

In the cattle world of undivided India, Hariana held a very important position, being the most important dual purpose (draught and milk) breed. It thrives well over a large area on this sub-continent. With the partition of India, its importance has still further increased as home tracts of Red Sindhi, Tharparkar and Sahiwal—three of the four important milch breeds, have gone over to Pakistan. The Hariana herd transferred to this Institute from Karnal in 1937 has been reorganized and a scientific breeding programme has been laid down with the object of evolving a high milk yielding strain of Hariana cattle which while attaining a higher ceiling of milk production, will at the same time retain its superior draught quality.

In nature it is found that certain breeds of animals are more resistant or susceptible to a disease or a group of diseases than others. Within a breed there is individual variation, i.e. certain individuals within a breed may resist diseases much better than the others. These variations have a genetical basis. Ranikhet is the most dreaded disease of fowls. With a view to evolving a strain of fowls genetically resistant to this disease 1,679 birds were inoculated with virulent Ranikhet disease virus. Out of these ,only three birds survived, showing the highly lethal character of the causative virus. These Ranikhet disease resistant birds are being multiplied by breeding. The birds of the successive generations will be exposed to Ranikhet virus and it is hoped that in each generation the mortality rate would go lower and lower ultimately producing a highly resistant strain of birds.

Inheritance of defective characters in farm animals

Most congenital abnormalities found in livestock affect their economic utility.



A portion of the experimental Hariana herd produced by artificial insemination

PLATE 22

They are, therefore, of considerable importance in animal breeding and production, especially when they have some hereditary basis. In India, all abnormalities of the feet or legs which affect the locomotivity of the cattle are of special significance as oxen provide by far the largest motive power in the country's agrarian economy. The mode of inheritance of two such defective characters, e.g. syndactalysm (uncloven hoof) in Hariana cattle, and flexed fetlocks in Gir and Hariana breeds have been studied. The mode of inheritance of a defective character in fowl expressed as a curled toe is also being investigated.

Climatological genetics

The study of the reaction of the many and varied breeds of Indian farm animals to differences in climatological conditions, is essential with a view to obtaining the maximum expression of the genetical constitution as regards their productivity and working qualities. Animals from one climatological region transported to a markedly different climatological region cannot always adapt themselves to the new environment, and as a result their health and productive capacity are adversely affected. It is known that some breeds of animals of some particular age can adapt themselves better to changed environmental conditions. The Hariana breed is being introduced in various climatic regions of India markedly different from its home tract. Studies are being conducted to determine whether there is any difference between various age-groups in this breed in their capacity to adapt themselves to changed climatological conditions.

Cytogenetics

Chromosomes are the bearers of the hereditary materials and in all hybridization work it is desirable to know the chromosome number and their morphology in the two species involved in the cross. Studies are being conducted in chromosome cytology in the Indian farm animals. The work on buffalo has been completed and that on goats and bulls is in progress. Studies on certain species of cattle and dog ticks and certain grasshoppers have also been carried out. This latter work was taken up mainly with a view to training research students in modern techniques of cytogenetics.

Artificial insemination

The chief limiting factor in the improvement of our livestock is their poor genetic ability. Betterment of the present day degenerated stock would, therefore, demand an improvement in the genetical make up for their economic characters like milk yield, draughtability, egg production, wool, carcase quality, etc. accompanied by better conditions of feeding and management. To bring about a rapid improvement in the genetic constitution the greatest possible use of superior sires should be made. This is possible by the extensive use of artificial insemination which is the most important biological technique at present passing into general practice. By means of artificial insemination it is possible to raise tens of thousands of lambs from a superior ram, and thousands of cows from a superior bull in a year, instead of 40 or 50 possible by natural mating. It, therefore, hastens improvement of breeds. Successful introduction of artificial insemination on a field scale stands out prominently amongst the notable achievements of this Section. Though one or two isolated attempts had been made in the past to take up artificial insemination in India, it is the planned work initiated by this Section which is chiefly responsible in making artificial insemination a practical proposition under the field conditions of India.

Systematic investigation on artificial insemination was started in this Institute in 1942 under a scheme sponsored by the Indian Council of Agricultural Research with a view to finding out suitability of the various techniques developed abroad

on collection of semen, its dilution, preservation and insemination under the conditions obtaining in India. Collaterally with laboratory research at Izatnagar, work on artificial breeding was extended to the neighbouring villages from 1944. Experience gained suggested that so far as the technique was concerned, there was no difficulty in utilizing the method in practical animal husbandry of the country. Besides technique, its large-scale application was found to depend greatly on organization. To study this organizational aspect, four developmental regional research centres were started between 1945-47 in Calcutta, Patna, Montgomery and Bangalore in addition to the one already working at Izatnagar. The centres showed progressive output of work from year to year demonstrating the increasing popularity of the method among the private livestock owners and the practicability of its utilization in spite of many difficulties. Upto 31 March, 1950, a total of 25,964 cattle, buffaloes, sheep, and goats were inseminated at these centres with an overall pregnancy rate varying from 60-75 per cent, which was decidedly better than what could be expected from natural mating. In connection with this work it was found that a large number of animals brought to these centres for insemination were suffering from reproductive disorders. To popularize the centres and to derive the maximum benefit from them, sterility service was allied with artificial insemination in these centres and upto 31 March, 1950, 4,678 animals were treated for sterility. At Izatnagar, on an average 1,000 animals are being inseminated annually. This work has greatly helped in the upgrading of the stock of the surrounding villages.

With a view to exploring the possibilities of meeting the demand from overseas countries for semen from the Indian cattle, the studies have been instituted to find out the maximum time of preservation of semen for optimum fertility and to evolve a suitable semen container for transportation. Calves have been obtained from the use of semen preserved upto 10 days and a cheap portable semen container has been designed. Researches on artificial insemination with poultry have also been conducted.

Semenological studies

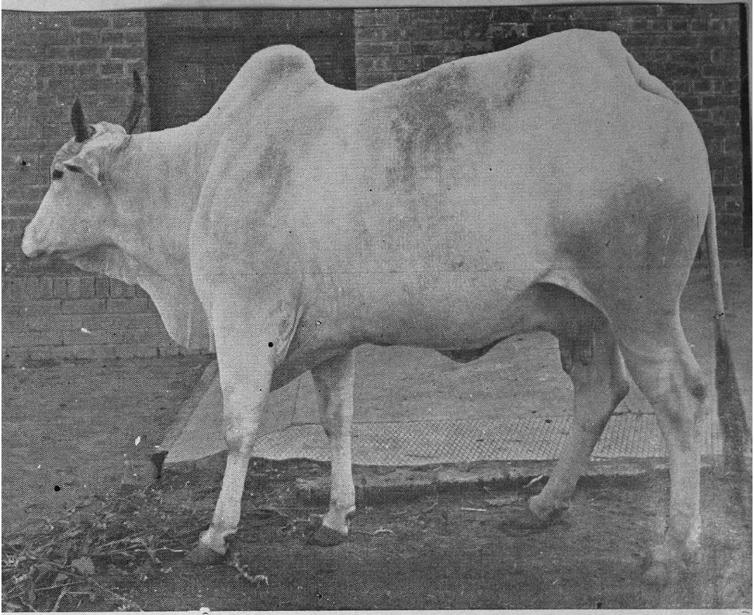
Systematic studies have been undertaken on the normal semen characteristics of different breeds of Indian livestock and the effects of various factors such as season, feed, management, and hormonal treatment on them. Work has been completed on the determination of the normal semen characteristics of a few breeds of cattle, buffaloes, rams and goats. Further work is in progress.

Studies on the seasonal effect on semen quality have revealed that in bulls, rams and goats, the quality deteriorates appreciably from August to October and it is best from February to April. It has been further found that there is a corresponding seasonal trend in the blood constituents of these species. Preliminary work with buffalo, indicates winter to be the worst and spring to be the best season.

The concentration of sugar (fructose), vitamin C and total reducing substances in ejaculated semen of buffaloes, rams, goats and fowls has been studied. The results are of great interest and are also expected to help in developing better dilutors for the semen of the species. Investigations into the biochemistry of the semen have revealed that the rate of destruction of semen sugar (Fructolysis) and sperm concentration are positively co-related. Fructolysis, therefore, can be used as a guide for evaluating the semen quality.

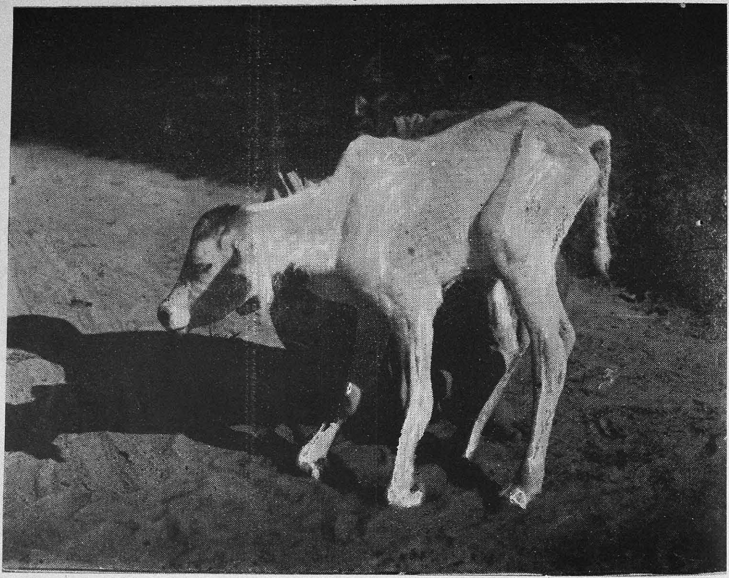
Experiments have been conducted to improve the quality of semen by treatment with hormone (Pregnant Mare Serum) * and also by feeding iodinated casein (thyroprotein). Results obtained from rams injected with Pregnant Mare Serum have indicated that this treatment has beneficial effect on semen quality. Semen from

* Described elsewhere in this article.



A sterile cow brought to lactation by hormone treatment. Elevation of the root of the tail and depression of lumbar region are characteristic of sterility

PLATE 23



A calf with hereditary defects in the fore-limbs

PLATE 24

goats fed on thyroprotein, did not show much improvement in quality. This might be due to the fact that the dosage of thyroprotein administered which was the same as used in foreign countries, was somewhat high for the Indian climate as the treatment was found to have an adverse effect on the respiration, body temperature and bodyweight of the animals. The work is being further continued with lower dosage of thyroprotein as this treatment has been found in other countries to have beneficial effect for curing 'summer sterility'.

The effect of nutrition on semen production is being studied. In this connection, it has been found that blood meal can be used to replace substantial portion of oilcakes in a ration without any deterioration of semen quality. The effect of low protein ration on semen quality is being investigated. Experiments have also been conducted to study the comparative quality of first and second ejaculates obtained in quick succession from buffalo bulls, behaviour of spermatozoa in the different levels of the male reproductive tract, and to evolve simple techniques for assessing semen quality.

Reproductive physiology

Information on normal reproductive physiological processes of Indian farm animals is lacking. Data have been collected for 10,405 animals from 46 established livestock farms throughout the country and are being sudied to ascertain (a) Gestation period (b) duration of oestrus (heat) (c) sex ratio (d) incidence of twins, triplets, etc. (e) incidence of abortion (f) age of maturity (g) the period of productivity, etc.

Studies have been completed so far for Sahiwal, Sindhi, Tharparkar, Gir, cross-bred Sahiwal, cross-bred Sindhi and cross-bred Gir cows for item numbers (a), (c), (d) and (e) above. The results of these studies will be of great importance in the animal husbandry practices as these will enable planning of more efficient breeding programmes. In addition, work is also underway to study the normal reproductive physiology of the Indian water buffalo.

Work has been initiated to induce multiple ovulation (liberation of egg) in Indian cattle with a view to transplanting fertilized eggs from genetically superior cows to those of inferior genetic make up, and make the uterus of the latter serve as the incubator for the developing embryos. This will find some useful function for scrub cows which can serve as foster mothers for intrauterine development of superior youngs from donor mothers.

Studies on infertility in Indian cattle

No detailed survey of the incidence of sterility in Indian livestock has yet been made to determine the causes and the frequency of different causal groups. Reliable statistics, therefore, regarding sterility or impaired fertility of Indian livestock are not available and the monetary loss this scourge produces is difficult to assess. It must obviously be very heavy. It is common knowledge that the Indian cattle are often slow in coming into heat (oestrus) and that their inter-calving period on an average is very long. A vast majority of cows do not calve every year, contrary to what it is in other countries having a progressive livestock industry, but on alternate years or even once in three years or more. Even if a fraction of the sterile or subfertile cattle could be made to get into calf and their intercalving period telescoped, the return in the shape of milk alone would be enormous.

Pregnant Mare Serum Gonadotrophin (P.M.S.) is a hormone present in high concentration in the blood serum of pregnant mares between 45-120 days of pregnancy. This has got the properties of stimulating gonads (testes and ovaries). As this hormone was difficult to obtain in this country and as the prices were prohibitive

extraction and purification of this hormone was undertaken. The product prepared at the Institute compares very favourably with costly commercial preparations. Several doses of the stuff have been distributed to provincial veterinary staff. Reports received from them are highly satisfactory.

Treatment with P.M.S. has been tried with success to shorten inter-calving period of cows and she-buffaloes which do not come into heat for long time after calving and also to induce fertility in late maturing heifers.

Preliminary work on restoring normal sex desire in bulls by use of P.M.S. has given satisfactory results.

Artificial lactation

A pilot experiment has been conducted to induce lactation in virgin heifers and dry barren cows which were cases of absolute sterility, by the administration of stilboestrol, a synthetic oestrin. Another experiment was conducted to study the effects of feeding thyroprotein on lactation induced by Stilboestrol treatment in goats. Feeding thyroprotein after Stilboestrol-induced lactation has reached its peak, appears to bring about further increase in milk yield. The application of these hormonal methods of induction and augmentation of milk yield has definite economic possibilities.

Sterilization of scrub cows

Investigations have also been initiated to find out painless, cheap and effective methods for making the unproductive cows sterile without causing any bloodshed.

In short, the Animal Genetics Section during its brief existence has initiated an organized attempt to introduce recent developments in the field of animal genetics to the solution of pressing problems of livestock industry in India, and has greatly helped in shaping the livestock breeding policies of the country on sound systematic lines.

The Section should have had a much more rapid expansion. Its development has been greatly hampered and many plans and projects of this Section have been kept in abeyance due to financial stringency. With the easing of the economic situation, it is hoped that high priority will be given to the all round development of this Section, so that it can render more active help in putting the animal industry of this country on a more rational and scientific basis.

125301

TRAINING FACILITIES

By S. DATTA

THE object of the conservation and development of livestock is to provide the requirements of human beings for maintaining and improving health and stamina by better feeding of more nutritious foods and to increase human comforts and happiness which result from protection from environmental influences and generate a feeling of satisfaction. Increasing the amount of highly protective foods of animal origin and making them cheaper and more readily available by better breeding and more balanced economic feeding of cattle are essential for the above purpose. Whatever may have been the achievements of organized livestock work so far, they are inappreciable when the requirements of the teeming millions of India's rising population are considered. Not only is the livestock wealth of India unique in its size and potentialities but the predominant position that it occupies among different industrial and agricultural commodities in respect of the annual service rendered to the national economy, makes it fundamentally important that this hitherto underdeveloped industry be brought to its proper status in the programmes of national reconstruction. The annual money value of Rupees five thousand crores of livestock products may not be fully visible for taxation or similar other purposes but if the livestock products were to disappear or the animals were to refuse to produce the services in kind which they render in supplying food, clothing, leather, hides, etc. national life would certainly become poorer.

Livestock research is thus essentially practical and economic in nature. The work carried out must be in the field and on the animals, whether the worker is engaged in the field to apply the knowledge and tools in his equipment or the research worker behind him in the laboratory forging and improving newer tools and expanding the resources of science, the object remains the exploitation to the maximum, of the resources and potentialities of livestock to achieve national prosperity through better agriculture and higher economic status and improved standard of living of rural population in particular and the community as a whole.

S DATTA is Director, Indian Veterinary Research Institute, Mukteswar and Izatnagar.

Veterinary education

Veterinary education, therefore, may be termed as 'inventive' and constantly on the march. The objective in veterinary education then is to produce forward-looking men able to participate in the growth and development of animal sciences on a broad-based general education, specialized knowledge and realistic application to the requirements of rural life and economy. The unrealistic urban consciousness of the intelligentsia does not generally appreciate that veterinary education is of as high a status and refinement as any other scholastic endeavour in universities. The pioneering work to be done for putting a national problem of such magnitude in its proper status requires men of outstanding abilities. The selection of students for admission into veterinary college warrants sufficient appreciation of the above requirements of individual merit and initiative in making the most of their careers. Promising men whenever found should therefore be given all possible encouragement and the facilities for preparing them for meeting the needs of the country should be ample and of the highest standard.

Five and six year courses are provided in some countries on an Intermediate in Science qualification. Indian colleges should also make it a point to achieve this aim in the long run.

With the changes in the political status of the country, India will have to prepare to be as self-sufficient in higher veterinary education as possible. The tendency of young Indians going abroad for veterinary and animal husbandry training has practically dwindled down, though no doubt certain countries, like Great Britain and the United States of America, have provided facilities for attracting Indian students.

Paucity of trained personnel

One of the major obstacles in the way of proper development of the livestock industry in this country has been the great paucity of trained personnel which is likely to be accentuated much in the next five years. India has about 10 veterinary surgeons per million livestock — a figure which is ridiculously small when compared with the corresponding figures of 95 and 248 for United Kingdom and Switzerland, respectively. Moreover, the rank and file of the Indian veterinarians of the past generation did not receive the facilities of a sufficiently broad-based training necessary for handling the immense problem of livestock conservation and improvement from all aspects. The number of veterinary colleges in India until the late 30's of this century was small and these used to run only short diploma courses. Generally, the student had no background of physics and biological science. The result was that they went out from the colleges to the field more or less like trained stockmen and thus found it difficult to win from their countrymen the respect and recognition which would have been their due. A trained animal husbandman should not only be a veterinary practitioner well versed in all prophylactic and curative therapies, but should also be capable of educating and guiding the *ryots* in the proper maintenance of their animals, by advising them about the provision of balanced diets, correct breeding and management. They will also have to play their part in catering to our countrymen wholesome meat and milk, through meat and milk inspection as well as through the proper preservation and balancing of feeds. All these require better equipped personnel to man the veterinary services. Fortunately, things have started moving towards the right direction. A number of new veterinary colleges have been started in our country. The minimum qualification in most of the colleges is I.Sc. with biology. Most of these institutions are also affiliated to universities. Some State Governments have also increased the pay scales of veterinary workers and it is hoped that this measure will attract better quality students to the profession. It is trusted that through such measures the recommendation of the Royal Commission on Agriculture held in 1926, about the provision of one veterinary assistant surgeon per 25,000 head of cattle, and one gazetted officer for each district, will be made good.

Educational facilities at the Institute

The nature of education given in the colleges is however mostly basic in character and cannot be more than the starting point of a man's professional career of constant sifting and adjustment of knowledge and experience to the actual realities encountered in the field. Further, such students get very little detailed training on the handling of modern tools, and knowledge of latest innovations. This fact had been recognized for some time past and a substantial part of the energy of the officers of this Institute has been canalized towards the remedying of this deficiency. One of the most important activities of the Institute has been the teaching of students. As the Institute is mainly devoted to research work, it under-

takes only post-graduate training of students in all branches of animal sciences. Not only are such facilities available to workers in this country, but have often been extended to scholars coming from the neighbouring countries like Iraq, Palestine, Ceylon, Siam, Burma, Malaya, China, etc. The Institute is also now affiliated to a number of Indian Universities and research work carried out here can be presented for M.Sc., Ph.D., and D.Sc. degrees of these Universities.

The dissemination of knowledge in advanced veterinary science to the country through the field workers has been the aim of the Institute from its very inception. In 1895, Dr Lingard, the then Imperial Bacteriologist, suggested to the Government for the preparation of lantern slides by the Institute and their issue to the veterinary colleges. In 1897, when two noted German scientists, viz. Koch and Pfeiffer visited the Institute at the request of Lingard, a conference of veterinary officers from all over the country was held at Mukteswar to demonstrate to them the inoculation method. From 1901, short courses of training in the method of preventive inoculations against rinderpest and other diseases were instituted. From 1922, in addition to the short courses of practical training imparted to the Indians and Europeans employed by either the civil or military authorities, a post-graduate refresher course for veterinarians was introduced. Regular training in pathology, serology, immunology, parasitology, and biological products was given to officers serving in the provincial and military veterinary departments of this as well as of various neighbouring countries. The duration of the course was 2½ months to start with but from 1933 was extended to 3 months and to 6 months from 1950. With the addition to the Institute of the newer sections of Animal Nutrition, Poultry Research and Animal Genetics and realization of the fact that a trained animal husbandman has not only to cope with disease problems but should also be able to advise the livestock owners about correct feeding, breeding and management policies, several other courses have been started in this Institute since 1944. Details regarding these courses will be given elsewhere in this article.

In addition to these regular courses a limited number of students are being admitted since 1943 in different subjects under the 'Rules for the grant of the Associateship of the Indian Veterinary Research Institute' for two years' training and research. Such students are expected to carry out under the supervision of experts, some research work of originality and merit and to present a thesis embodying the results obtained. On the thesis being approved by a Committee of Examiners, the students become entitled to the award of the Associateship.

It has been mentioned before that the Institute is affiliated to several Universities for post-graduate training. Several honorary research workers have been admitted from time to time for such training and a number of them have received post-graduate degrees. Four officers of the Institute, viz. Dr J. T. Edwards, Dr S. Datta, Dr S. K. Sen, Dr G. D. Bhalerao and Dr P. A. Seshan have obtained D.Sc. degrees of the London, Edinburgh, Bombay, and Madras Universities respectively by presenting thesis based partly or wholly on the researches carried out at the Institute. Besides these, nine workers of this Institute have received Ph.D. degrees and several others the M.Sc. degrees.

The details of the different regular training courses are indicated below:

Post-Graduate Refresher Course in Veterinary Science: This course starts annually from about the 1st of April. Its duration is six months. Training is imparted in pathology, bacteriology, immunology, protozoology, helminthology, entomology, biochemistry and statistics. The minimum qualification required for admission is a degree or diploma from a

recognized veterinary college. Those with higher basic education and experience are likely to derive more benefit. The total number of seats is 20.

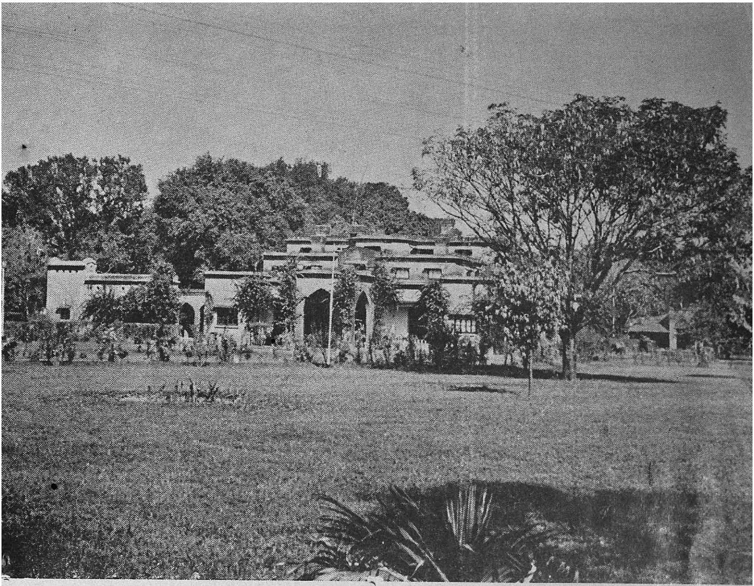
Advanced Course in Animal Husbandry: This course covers a period of eight months from about the middle of August each year. The first five months are spent at the Indian Veterinary Research Institute, Izatnagar, with a short visit to the Mukteswar branch in September. The remaining period is spent in part at the Indian Agricultural Research Institute, New Delhi, and its substation at Karnal; Government Livestock Farm, Hissar; Polson's Model Dairy; Anand Government Creamery, Choodi; Haffkine Institute; Malad Dairy Farm in Bombay; Bombay Veterinary College; Milk Distribution Plan, The Arey Colony; Indian Dairy Research Institute, Bangalore; Government Livestock Farm, Hosur, etc.

The course includes lectures and practicals on the science of mixed farming and fodder production, management of pedigree herd, general management of herds and flocks, animal nutrition, poultry husbandry, animal genetics, and production and grading of wool, hides and skins. The minimum qualification required for admission is a degree or diploma in Veterinary Science or Dairying or Agriculture with experience of livestock. The total number of seats is 30.

Advanced Course in Poultry Husbandry: This course is of six months' duration and starts in about the middle of October each year. Students have to undertake a short visit to Mukteswar-Kumaun and to some other important poultry farms. Training both theoretical and practical is imparted in anatomy and physiology of fowls, poultry, husbandry, pathology, helminthology, entomology, genetics including artificial insemination, nutrition, technology, statistics and farming with reference to poultry. Admission to this course is restricted to graduates in veterinary science, agriculture, dairying or M.Sc. in pure sciences. The total number of seats is 20.

Course of training in the technique of manufacture of sera and vaccine, etc. This course covers a period of nine months of which first four months are devoted to training at Mukteswar and the remaining period at Izatnagar. It starts from mid-July and in view of the limited laboratory accommodation only six students are admitted at a time. Admission to the course is restricted to persons who possess a degree or diploma in veterinary science from a recognized veterinary college, and preference is given to those who have experience of laboratory work. The demand for this course will naturally be limited and it is held only when a sufficient number of candidates applies for it. The students may visit certain Institutes, namely, (i) Central Research Institute and Pasteur Institute, Kasauli (ii) Vaccine Depot, Patwadangar (iii) All-India Institute of Hygiene and Public Health, and School of Tropical Medicine, Calcutta (iv) King Institute of Preventive Medicine, Guindy, Madras (v) Veterinary Serum Institute, Bangalore (vi) Haffkine Institute, Bombay, etc.

The course includes both theoretical and practical training in (1) general laboratory technique with special reference to bacteriological aspects, including preparation and sterilization of glassware and culture media (2) principles and practice of immunity including principles governing the preparation and use of bacterial and virus vaccines, immunogens, toxins, antisera, etc. (3) preservation of bacterial cultures, sera and other biological materials (4) physiology and chemistry of blood and elementary immuno-chemistry (5) fractionization of antisera, concentration, drying and special methods of preservation risks, dangers and accidents in the manufacture to be guarded against particularly (6) standardization of toxins, antigens, and biological products (7) systematic preparation of various biological products (8) study of layout of a laboratory for the manufacture of biological products and its require-



Director's Office, Izatnagar

STUDENTS UNDERGOING TRAINING AT THE INDIAN VETERINARY RESEARCH INSTITUTE, IZATNAGAR (JANUARY, 1951)

Sitting—(Left to right) : Subharngkasen (Thailand), C. K. Subbusingh (Madras), V. Singaravelu (Hyderabad), R. M. Kalapeshi (Bombay), B. A. Shirazi (Madras), S. Datta (Director), B. M. Roy (Hyderabad), Kedar Nath (U. P.), S. Parthasarthy (Mysore), Praving Samakoses (Thailand), J. D. Bhist (U. P.).

Standing—1st row : M. N. Goswamy (Assam), J. Ramamurthi (Madras), N. M. Solanki (Sourashtra), M. N. Jamdar (Madhya Pradesh), P. Subramanian, (Madras), S. K. Verma (Patiala), U. S. Aswathanarayan (Madras), R. S. Sinha (Bihar), R. N. Chaudhari (Bihar), S. S. Misra (Bihar), O. N. Sinha (Bihar), R. Vijayarangam (Madras), M. Kameshwara Rao (Madras), G. A. Sastry (Madras).

2nd row : J, Das (Orissa), S. Sinha (U. P.), P. Narayan (Bihar), B. B. Singh (U. P.), R. P. Singh (U. P.), S. C. Sundarachari (Madras), A. S. Sinha (Bihar), K. M. N. Srivastava (U. P.), R. K. Punshi (Punjab), P. K. Mukherjee (W. Bengal), K. R. Gulati (Punjab).

3rd row : Lee Chin Hua (Malaya), D. S. Bhatnagar (U. P.), J. P. Pradhan (Nepal), Dhanna Singh (Punjab), R. D. Singh (U. P), S. Singh (U. P.), P. G. Nair (Travancore-Cochin).

PLATE 26

ments (9) management and upkeep of experimental animals required for the preparation of biological products (10) preparation of culture for immunization of animals (11) testing of sera with reference to bacterial count and *p*H estimation (12) bottling, storage and despatch of biological products (13) general administration and maintenance of records on cost and commercial basis, supervision over technical staff and handling of labour and maintenane of muster-rolls and (14) legal requirements under statutory laws in different countries.

Advanced course in artificial insemination and physico-pathology of reproduction: This course covers a period of six months with a maximum of 12 students at a time. Admission is restricted to persons holding a degree or diploma in veterinary science or animal breeding and genetics or in agricultural science (animal husbandry group), or in dairying. The course includes theoretical and practical training in (i) fundamentals and technique of artificial insemination in farm animals (ii) the advantages and disadvantages of artificial insemination (iii) problems and procedure in managing artificial breeding centres with special reference to India (iv) general physiology of reproduction and the related internal secretions in the domesticated animals and (v) the study of permanent and temporary sterility in farm animals and their courses.

Hostel accommodation

At Mukteswar residential quarters have been built only for eight students. The other students are provided with rent-free accommodation in such Government buildings as may be vacant at the time. At Izatnagar two private houses have been rented for use as students' hostel. The students have to make their own arrangements for food. It is proposed to construct a hostel for 100 students in the Institute area at Izatnagar and a hostel for 60 students at Mukteswar, as and when opportunities occur.

Complete information on the total number of students who attended the various set courses and extension classes during the last sixty years are not ready at hand. The following information will indicate roughly the minimum number of students who have passed the different courses:

Number of Students trained during 1890—1950

Period	Name of course	No. of students
1901-1950	Practical training	1,096
1922-1950	Post-graduate course in veterinary science	305
1940-1950	Advanced course in animal husbandry	178
	Advanced course in poultry husbandry	120
	Manufacture of sera, vaccines, etc.	11
	Advanced course in artificial insemination and physico-pathology of reproduction	107
	Research scholars for Associateship	21
	Honorary Research workers	6
	Total	1,844

Tuition charges

The students are charged Rs. 26 per mensem for each course taken up by them. Besides these, those scholars at Izatnagar, who are willing to avail of hostel accommodation, have to pay a seat rent of Rs. 6 per mensem.

Research scholarships

One research scholarship of Rs. 150 per mensem is given to one student to conduct research in certain specified subject. In the reorganization plan of this Institute, the provision of six fellowships of Rs. 250 each per mensem has also been recommended. Recently the Indian Council of Agricultural Research has also agreed to

the award of fellowships to scholars working in this Institute @ Rs. 200 per mensem in the following subjects: (1) Animal pathology (2) animal bacteriology (3) animal physiology and (4) animal parasitology. The period will be two years in each case.

Teaching staff

The Director of the Institute, the Heads of Research sections and other Class I and Class II scientific workers at the Institute participate in the teaching work. A few outside experts are also invited to give lectures on their special subjects, e.g. forestry, marketing, drugs, cooperation, etc.

The above description gives a brief abstract of the training facilities available in this Institute. With the advent of the Independence, the attempt at the improvement of our livestock and especially the cow has been and is being continually intensified. In order to increase the number of trained men, new veterinary colleges have been established and it is likely that more of them will be opened in the near future. It is, however, essential to ensure that these colleges have approved teachers of the highest stamp. At present, it must be admitted that the number of persons to man such posts is very limited. The Institute has vigorously contributed its quota to the extent it has been practicable with its limited resources. But in spite of the regular flow of trained students from our laboratories and even the departure of certain of our senior officers as heads of colleges, the demand has been far in excess of the supply and is likely to increase further when livestock development is taken up in all earnestness in all the states and a concentrated drive is made to eradicate the contagious diseases of livestock. The question of reorganizing and extending the existing facilities for post-graduate training at the Institute has therefore been considered in the light of the experience gained and with special reference to the recommendations of the Scientific Man-Power Committee and proposals on the subject have been submitted to the Government of India. These include the following of which some have already been implemented with Government approval:

(i) Extension of the duration of the post-graduate refresher course in veterinary science from three to six months, so as to cover all the subjects in their present state of advancement, in which the Institute is now in a position to give instruction.

(ii) Amalgamation into one six months' course of the two existing three months' courses for training in the technique of artificial insemination in animals and training in the investigation of sterility of cattle.

(iii) The provision of a new course of all-round training for veterinarians leading to the grant of a post-graduate Diploma in Tropical Veterinary Science (D.T.V.Sc.) particularly with a view to improving the general standard of veterinary education in the provincial veterinary colleges by arranging for the training of better type of teachers. The persons admitted to this course will be required, in the first instance, to go through the new six months' post-graduate refresher course in veterinary science. Thereafter those showing the greatest promise will be selected to undergo a specialized intensive training in one of the two following groups of subjects, viz. (1) Animal bacteriology, animal pathology and animal parasitology and (2) animal genetics, animal nutrition and poultry science, leading to the grant of D.T.V.Sc. Those who have already received

training in the post-graduate refresher course in veterinary science for three months under the old arrangement or for six months under the new arrangement will have allowance made for the training already received by them. The number of students admitted for specialized training in each of the two abovementioned groups of subjects will be twelve at a time and a new batch will be admitted after the previous one has completed its training, i.e. every alternate year. The D.T.V.Sc. course is meant for the meritorious veterinarians who by virtue of the specialized training, will be able to guide other people in different branches of the profession in the field as well as in the colleges.

Central College

Sometime back a proposal to open a central Animal Husbandry College was mooted. The need for the opening of such a college has been accepted in principle by the Government of India, but there has been a controversy over the question of its location. It may be pointed out that there already exists at this Institute a very good nucleus for such a college. In fact, this Institute has perhaps the best claims to have the college associated with it. For, this Institute possesses specialists in practically all the various branches of animal husbandry. No other place in India has at present or is likely to have for a long time to come either the quality of staff or the equipment and apparatus as is available here. As a result of the association of both advanced teaching and research in the Institute over these long years, the high quality of teaching that has developed on all aspects of animal husbandry work is not likely to be readily attained at any one place in the country. There can be no doubt that the teaching of the students should be undertaken by men who are experts in their respective special branches of knowledge. If a separate animal husbandry college is established away from this Institute, there will either be a drift of experts from this Institute or men of less experience may have to be recruited for it, most likely the latter. In foreign countries, particularly in the U.S.A., research work and teaching are complementary to each other. If the central Animal Husbandry College is located at Izatnagar, a considerable financial saving may be expected, as a good deal of the teaching work can be entrusted to the senior research workers of this Institute, in addition to their own duties, as is done in the Calcutta School of Tropical Medicine. Also many of the costly instruments can be shared.

If all these recommendations are given effect to, it is hoped that the number of highly trained personnel can be multiplied very rapidly. In addition, help from international sources is expected in training a few workers of the Institute in subjects for which facilities do not exist in the country.

GENERAL ORGANIZATION AND ADMINISTRATION

By B. R. RAMCHANDANI

THE Imperial Bacteriological Laboratory, at the time of its inception, was under the control of the Government of Bombay. The Officer-in-Charge was designated the Imperial Bacteriologist who also held the post of professor of comparative pathology and bacteriology in the Civil Veterinary Department of India. The laboratory was shifted to Mukteswar in 1893, when it was placed under the charge of the Inspector General, Civil Veterinary Department. The construction of the main laboratory was completed in 1895 and the staff then consisted of the Imperial Bacteriologist, one assistant Bacteriologist, one Laboratory Assistant, three clerks, one Artist and some *mazdoors*. In 1898, the Director General, Indian Medical Services took charge of the laboratory. It is interesting to recall here that in 1899, at the instance of Home Department of the Government of India, a Committee including Heads of medical and veterinary services, recommended the establishment of a central medical research laboratory also at Mukteswar, in conjunction with Veterinary Bacteriological Laboratory there. This clearly shows that Mukteswar was considered by both the medical and veterinary experts of that time to be an ideal place for research, and also the essential kinship between the two branches of science. In 1901, its control reverted to the Inspector General, Civil Veterinary Department. The laboratory was destroyed by fire in 1899. It was rebuilt in 1902.

With a view to carrying out certain investigations during winter in the plains, a branch laboratory was built in 1901 at Kurgaina, Bareilly, which was transferred in 1922 to its present site at Izatnagar. This site was acquired in 1913 but due to war, the contemplated developments could not be undertaken. The control of the laboratory was passed on in 1912 to the Agricultural Adviser to the Government of India, consequent on the abolition of the post of Inspector General, Civil Veterinary Department. In 1925, the name of the laboratory was changed to Imperial Institute of Veterinary Research. On the recommendations of the Linlithgow Commission on Agriculture, the post of the Agricultural Adviser was abolished, and the Institute was placed directly under the Government of India in the Department of Education, Health and Lands and the Director was declared as the Head of the Department with the usual administrative and financial powers attached to such a post. In 1936, the Institute was renamed Imperial Veterinary Research Institute the word 'Imperial' being replaced by 'Indian' in 1947.

B. R. RAMCHANDANI is Administrative Officer, Indian Veterinary Research Institute.

Organization of the staff

In view of the expansion of research and technical activities of the Institute the work was organized into research sections first in 1931. There are at present however six research sections viz. (1) Pathology and bacteriology (2) biological products (3) parasitology (4) animal nutrition (5) poultry and (6) animal genetics. Headquarters of the first and third are situated at Mukteswar while those of the rest are at Izatnagar. Each of the sections is under an Officer-in-Charge, who is responsible for initiating and guiding research of his particular section and acts as an adviser in his field of science to the

officers of the central and State departments, scientific organizations and private livestock owners. He is assisted by Research Officers, Assistant Research Officers, Research Assistants and other technical staff, the number of such persons depending upon the requirements of work of each section and its stage of development. In addition, clerical assistance is provided to each Officer-in-Charge.

The Director is both the scientific and administrative Head of both the branches of the Institute. He coordinates and canalizes the work of the various sections and also acts as an adviser to central and State Governments on intricate animal husbandry and veterinary problems. Up to 1936-37, the Director's headquarters were at Mukteswar throughout the year. Subsequently he used to stay for a few months at Izatnagar. But in view of the present set up of research sections with emphasis on Izatnagar, the headquarters of the Director are at Izatnagar for the major portion of the year.

In order to provide facilities to the research sections the following service sections are in existence: (1) Administration (2) veterinary (3) estate (4) engineering and (5) medical.

Administration

Up to the end of 1929, the Director's senior assistant on the administration side was a non-gazetted Office Superintendent. But as the activities of the Institute increased, the post of an Administrative Officer was created in 1929. Owing, however, to financial stringency the post of the Administrative Officer then designated as Personal Assistant was reduced to a class II status in 1931.

With the addition of more research sections at Izatnagar, a similar post was created in 1940 for the Izatnagar central office. For a few years since 1939, Mr. J. R. Haddow, who was the seniormost Veterinary Research Officer worked as Deputy Director in addition to his routine duties. In 1945, however, it was considered essential to have an officer to assist the Director in administrative matters, so that the work of the Institute may be carried out smoothly, efficiently and promptly and the Director may be able to give more time to his own research and supervision of the scientific investigations carried out in the Institute. The post of the Administrative Officer was revived and the designation of the Personal Assistants at Mukteswar and Izatnagar was changed to Assistant Administrative Officers. The Administrative Officer works directly under the supervision and control of the Director and remains at Izatnagar throughout the year but visits Mukteswar as and when required to collate the work of the two offices.

The administrative work has not only grown in volume but also in complexity in view of the recent developments in the country, as also due to various factors which have arisen within the Institute. The staff has increased considerably due to the addition of three new sections, increased demand on the Institute's services, e.g. for biologicals, pedigree poultry and eggs increased training courses, difficulties of arranging supplies chemicals, apparatus and equipments. Strengthening of the staff is required by the addition of Accounts Officer to look after the large financial operations on both the revenue and expenditure sides, and of two Supply Officers, one for each of the branches at Mukteswar and Izatnagar, to ensure speedy procurement, proper storage and prompt supply of all kinds of stores essential for the discharge of the Institute's work.

There are two central offices—one at Mukteswar and the other at Izatnagar. Each has four sub-sections, viz. General, Accounts, Stores and Records.

Veterinary Section

Izatnagar: This section is in the charge of a class II Veterinary Officer. The duties of the section are routine immunization of the Institute's animals, treatment of the

sick animals and disposal of certain discarded animals and of hides and skins of dead animals. He also looks after the animal husbandry museum at Izatnagar.

Mukteswar: This section is also in the charge of a class II Veterinary Officer who is responsible for the purchase, maintenance and disposal of animals kept at Mukteswar both for transport and experimental purposes.

Estate Section

Mukteswar: This section is under the charge of a class II officer, who is designated as Estate Manager. The cultivation areas here are distributed at considerable distances from each other and hill cultivation has its own peculiar problems. The Estate Manager looks after the management of cultivation, the reserve forest (assisted by the Deputy Ranger) and the procurement, storage and distribution of animal feeds. In addition, he undertakes minor departmental constructions, and repairs and is also responsible for the watch and ward of the Estate.

Izatnagar: The duties of the Estate section at Izatnagar are also of an identical nature except that there is no fores irrigation facilities exist. This section is also under the charge of a class II officer who works under the guidance and control of the Officer-in-Charge, Animal Genetics Section. The Estate Manager also looks after the sanitation of the Institute area.

Engineering Section

Mukteswar: The isolated situation of Mukteswar is such that it is not possible to obtain supplies of electricity, water and gas from any outside source and, as a result, the Institute is compelled to maintain an engineering section of a considerable size. In addition to the supply of electricity, water and gas, the duties of this section include maintenance and repair of laboratory equipment and manufacture of certain articles and apparatus. The staff of this section has been expanded from time to time to meet the growing needs of work and the requirements of the Factories Act and the rules thereunder, which are applicable to the power house. The old engines in use at present are now out of date, and a new set has been ordered and is expected to be fitted up next year.

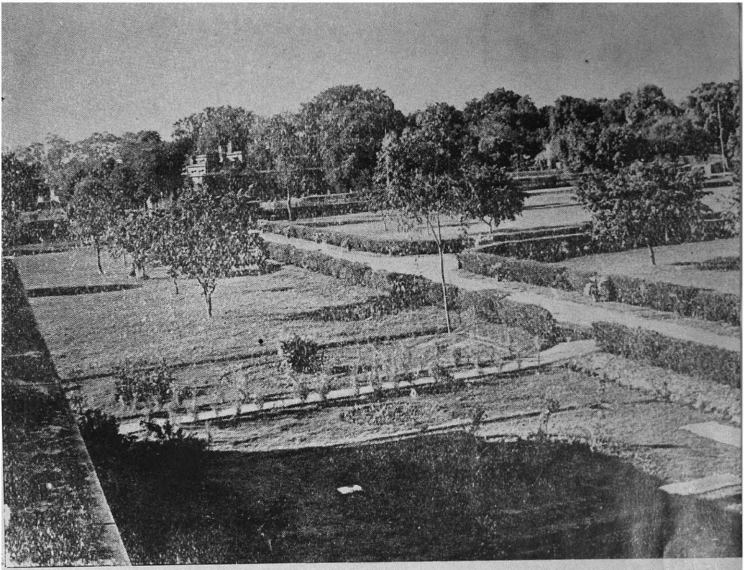
Izatnagar: At Izatnagar, electricity is obtained from the Bareilly Electricity Supply Company, while the water supply which is derived from two tube-wells, is the responsibility of the Central Public Works Department.

The small engineering section produces and supplies gas, and is responsible for the maintenance, and repair of laboratory equipment. The section is understaffed. It is also not provided with a proper type of workshop.

Medical Section

Mukteswar: At Mukteswar a whole-time class II Medical Officer is provided to look after the health of the Institute employees and their families. There is also a fairly well-equipped hospital, including a dispensary, an operation theatre, wards for in-patients, etc. The immediate needs of the Medical Section in respect of equipment and additional accommodation are, an X-Ray apparatus and an X-Ray room, which will be of great help in diagnosis. It is also desirable to have a lady Sub-Assistant Surgeon to assist in the medical examination and treatment of women patients and to work also as anaesthetist.

Izatnagar: The existing arrangements for the medical care of the Institute's employees at Izatnagar and their families are highly unsatisfactory and inadequate. At present only a part-time Medical Officer is provided who attends the Institute dispensary for about a couple of hours a day. Proposals for the improvement of these arrangements by the provision of a properly equipped and adequately staffed hospital under the control of a whole-time Medical Officer have accordingly been submittted to Government.



A portion of Izatnagar Estate

PLATE

A corner of the Library at Izatnagar

PLATE 28

Library

The Institute library at Mukteswar has perhaps one of the best collection of veterinary literature in the East. There is a comparatively smaller library at Izatnagar also. In the absence of properly trained librarians however full benefits out of these are not being derived. Publications are supplied on loan to State departments.

Total strength of staff

The staff originally consisted of two gazetted officers, one laboratory assistant, three clerks, one artist and some class IV servants. Today, after an interval of 60 years, the position is as follows:

Class I	23
Class II	24
Class III	177
Class IV	252
• *Mazdoors*	850

Receipts and expenditure

This Institute is essentially a research organization and as such a spending department. But receipts of considerable size are obtained from the sale of sera and vaccines, milk, animals, poultry and hides and skins. The returns from eggs and poultry can be increased substantially.

In 1901-02 the receipts totalled Rs. 9,026-13 and in 1950-51 the receipts amounted to Rs. 9,22,000.

Land and buildings

The land at present at the disposal of this Institute at Izatnagar was acquired in 1913 to meet the requirements of only the Biological Products Section and its animals. With the addition of the Animal Genetics, Animal Nutrition and Poultry Research Sections, a large number of experimental animals have been added to the Institute's livestock. The area available for cultivation and grazing has been reduced owing to the utilization of a portion of the land for the construction of additional laboratories, animal stalls and residential buildings. Some more area will have to be utilized for these purposes in connection with the reorganization and expansion now contemplated. The area available for cultivation and grazing will, therefore, be further reduced. On the other hand, the number of experimental and other animals will be considerably increased. The Institute is, therefore in urgent need of more land both for growing fodders and for residential and laboratory accommodation. Land for acquisition is available and it will be wise to take steps to secure it.

Supplies and stores

This Institute requires annually a large amount of stores consisting of chemicals, laboratory apparatus, engineering spares, serum bottles, packing material, clothing and animal feeds. The purchases are made according to rules and regulations laid down by the Government of India. Purchase of animal feeds and their distribution is carried on by the Estate Section while purchase of other stores is carried on by the Administrative Officer. Izatnagar and particularly Mukteswar being situated, as they are, away from big cities and marketing centres, arrangements for obtaining the above supplies have to be made well in advance, and this forms one of the constant worries of the administration. It is, however, felt that to carry out the work promptly and efficiently the staff available at present is not sufficient and the appointment of a Supply Officer for the purpose will be of great help.

THE INSTITUTE STAFF

Director

Dr S. Datta, D.Sc., M.R.C.V.S., F.R.S. (Edin), D.T.V.M., F.N.I.

Pathology and Bacteriology Section

(Established — 1890)

Officer-in-Charge : Mr. M.R. Dhanda, L.V.P., M.S. (Michi.), Dip. Bact. (London)

Research Officers :	
Disease Investigation	Mr. P. R. Krishna Iyer, G.M.V.C.
Pathology	*Vacant*
Bacteriology	*Vacant*
Assistant Research Officers :	
Virus Disease	Mr. C. Seetharaman, B.Sc., G.M.V.C., B.V.Sc.
Bacteriology	Mr. J M. Lall, L.V.P.
Disease Investigation	Mr. N.S. Sankaranarayanan, G M.V.C.
Biochemistry	Dr R. Mukherjee, M Sc., Ph.D. (Dacca)
Research Assistants :	Mr. Manmohan Singh, L.V.P.
	Mr. N.S. Datt, L V.P.
	Mr. T P. Banerji, B.Sc., G.V.Sc.
	Mr. K.P. Balakrishnan, G.M V.C.
	Mr S.L. Mukherjee, G.B.V.C.
	Mr. S.L. Issar, G.V.Sc.
	Vacant
	Vacant
Research Assistant (Statistics) :	Mr. S. Sen, M.A.

Schemes (*Indian Council of Agricultural Research*)

Investigation of Tuberculosis and Johne's disease :	
Research Officer	*Vacant*
Assistant Research Officer	Mr. Gajinder Singh, B.Sc., L.V.P.
Research Assistant	Mr. M.S. Jayaraman, G M.V.C.
Vaccination of cattle against Foot-and-Mouth disease :	
Assistant Research Officer	Mr. V.R. Gopalakrishnan, G M V.C.
Research Assistant	Mr. Harbans Singh, B.A., L.V.P.
Investigations on diseases caused by anaerobes :	
Assistant Research Officer	Mr P.R. Nilakantan, G.M.V.C., B.V.Sc.
Research Assistant	Mr. P.C. Ganguli

Biological Products Section

(Established — 1901)

Officer-in-Charge : Mr. Balwant Singh, G.P.V.C.

Research Officer :	
Production	*Vacant*
Assistant Research Officers :	Mr. S.K. Chaudhuri, G.C.V.C.
	Mr. K.C. Sinha, G.B.V.C.

Research Assistants	Mr. Gopal Rai, G.P.V.C. Mr. D.R. Uppal, B.A., G.B.V.C. Mr. Shanti Saroop, L.V.P. Mr. H.S. Mehta, G.V.Sc.

Parasitology Section

(Established — 1931)

Officer-in-Charge : Dr H.N. Ray, M.Sc., Ph.D. (Lond.)

Research Officers :	
Entomology	Dr B.C. Basu, M.Sc., D.Sc. (Cal.)
Helminthology	Dr H.D. Srivastava, M.Sc., D.Sc. (Alld.)
Protozoology	Post temporarily transferred to Poultry Research Section.
Assistant Research Officers :	
Entomology	Mr. P.B. Menon, B.A.
Helminthology	Mr. C.T. Peter, G.M.V.C., B.V.Sc., M.Sc. (Vet.)
Training	*Vacant*
Research Assistants	Mr. P.G. Deo, M.Sc. Mr. C.M. Sen Gupta, G.V.Sc. Mr. G.A. Shivnani, G.B.V.C. *Vacant*

Schemes (*Indian Council of Agricultural Research*)

Research into the damage caused by ticks to hides and skins :

Assistant Research Officer	Mr. B.N. Soni, B.Sc. (Agri.) (Edin.)
Research Assistants	Mr. C.F. Mataney, G.B.V.C. Mr. D.D. Nagpal, B.V.Sc.

Investigation into the life history of helminth parasites:

Assistant Research Officer	Mr. S.C. Dutt, M.Sc.
Research Assistant	Mr. K.M. Mehra, M.Sc.

Scheme for helminthic parasites affecting poultry in India and their control :

Research Assistant	Mr. P.K. Sinha, B.Sc., G.V.Sc.

Animal Nutrition Research Section

(Established — 1936)

Officer-in-Charge : Dr N.D. Kehar, M.Sc., Sc.D. (Johns Hopkins)

Research Officers :	
Physiology	Dr S.N. Ray, M.Sc., Ph.D. (Cantab.)
Pathology	*Vacant*
Assistant Research Officers :	
Physiology	Dr D.N. Mullick, M.Sc., Ph.D. (Aberdeen.)
Biochemistry	Dr B.N. Majumdar, M.Sc., Ph.D. (Bomb.) Dr K. Chandra, B.Sc. (Agri.), Ph.D. (Durham), T.D., (Leeds)
Training	Dr A.K. Pal, M.Sc., Ph.D. (Edin.), Dip. Agri. (Edin.)

Research Assistants	Mr. A W. Zubairy, M.Sc., B.T.
	Mr. V.N. Murty, M.Sc.
	Mr. S.S. Negi, M.Sc.
	Mr. B.C. Joshi, M.Sc.
	Mr. B. Sahai, M.Sc.
	Mr. I. Kumar, M.Sc.
	Mr. P. N. Johari, M.Sc.
	Mr. Brahma Datt, B.A., L.V.P.
	Vacant
	Vacant
Farm Superintendent	Mr. S.L. Talwar

Schemes (Indian Council of Agricultural Research)

Determination of nutritive value of certain indigenous grasses and leafy fodders :

Research Assistants	Mr. M.M. Jayal, B.Sc. (Agri.)
	Mr. B.S. Gupta, M.Sc.
Supervisor	Mr. M.L. Sadana, B.Sc.

Investigation on sheep nutrition :

Assistant Research Officer	Mr. P. C. Sawhney, M,Sc.
Research Assistants	*Vacant*
	Vacant

Scheme (Indian Central Oilseeds Committee)

Investigation of nutritive value of different oilcakes produced by ghani *and expeller processes* :

Assistant Research Officer	Dr K. Sahai, M.Sc., Ph.D. (Agra)
Research Assistants	Mr. A.N. Bahl, M.Sc.
	Vacant
	Vacant
	Vacaut

Poultry Research Section

(Established — 1938)

Officer-in-Charge : Mr. S.G. Iyer, G.M.V.C.

Research Officers :	
Pathology	Mr. S.B.V. Rao, L.V.P.
Protozoology	Dr T.S. Krishnan, M.Sc., Ph.D. (Madras)
Assistant Research Officers :	
Biochemistry	Dr S. Bose, M.Sc., Ph.D. (Lond.)
Poultry	Mr. H.P. Tandon, L.V.P.
Training	Mr. B.M. Thakral, L.V.P.
Industrial Chemistry	Mr. Ram Narain, M.Sc.
Research Assistants	Mr. T.D. Mahadevan, B.Sc.
	Mr. S. Narayan, G.M.V.C., B.V.Sc.
	Mr. D.R. Ramnani, G.B.V.C.
	Vacant

INDIAN VETERINARY RESEARCH INSTITUTE STAFF, MUKTESWAR-KUMAUN

1st row: Left to Right: M. Singh, S. Sen, Mrs. E. Chapman, P. S. Negi, Gajindar Singh, V. R. Gopalakrishnan, B. N. Soni, K. C. Pant, M. R. Dhanda, H. N. Ray, P. C. Atkinson, R. Mukherjee, J. M. Lall, P. C. Ganguli, M. S. Menon, D. K. Makhijani, Harbans Singh, Mrs. G. T. Wheeler, K. D. Pande, P. R. Nilakantan.

2nd row: H. C. Joshi, Kamlapati Nogai, J. S. Bisht, Sukna Ram, J. Wheeler, Partap Singh Negi, H. R. Dilawari, B. D. Joshi, T. P. Banerji, B. K. Kathuria, G. A. Shivnani, R. N. Seth, C. F. Mataney, M. S. Jayaraman K. P. Balakrishnan D. D. Nagpal, B. L. Sah, K. S. Nayal, U. S. Jain, P. N. Khatri, P. D. Pande, I. Timothy, Latif Khan, J. D. Joshi, Gulab Singh, Simon Das, Harish Chandra.

PLATE 29

INDIAN VETERINARY RESEARCH INSTITUTE STAFF, IZATNAGAR

2nd row (Sitting) (on chairs) K. Chandra N. S. Sankarnarayan B. N. Majumdar D. N. Mullick S. S. Prabhu S. B. V. Rao S. N. Ray, B. R. Ramchandan, S. G. Iyer, N. D. Kebar. S. Datta (Director), P. Bhatta-charya, Balwant Singh, B. C. Basu H. D. Srivastava, P. R. K. Iyer, T. S. Krishna, D. P. Mukherjee, S. K. Chaudhuri, H. B. Pandey P. B. Menon.

3rd row (Sitting) on stools Brahma Dutt, C. M. Sen Gupta, B. Sahai, B. C. Joshi. S. S, Negi, P. G. Deo, A. W. Zuberi, S. L Mukherjee, A. K. Pal, K. Sahai, K. C. Sinha, H. P. Tandon, B. M. Thakral, P. C. Sahani, S. C Dutta, C. T, Peter, M. P. Johari, Chet Ram, S. R. Saxena, Gopal Rai, D. R. Uppal, Shanti Swaroop. S. R. Ganguli S. N. Luktuke

4th row (Standing) Pratapman, U. D. Sharma, D.R. Rammani, S. N. Chatterje, K.D. Bhaya, P, K. Sinha, A. N. Bahi, B. S. Gupta, Sundar Singh, S. L. Issar, K.N. Mehra, P.N. Johari, Indar Kumar, H. S. Mehta, S K. De, A. Mukherjee L. R. Sah, J. C. Naithani, M. L. Sadana, H. D. Pant. L. D. Pande, B. A. Agarwal, Shanti Prasad, K. R. Diwakar, M. J. Davia, M. Simpson.

PLATE 30

Farm Superintendents :	
Poultry	Mr. K.N. Joshi
Military Poultry Farm	*Vacant*

Animal Genetics Section

(Established — 1944)

Officer-in-Charge : Dr P. Bhattacharya, M.Sc., Ph.D. (Edin.)

Research Officer :	
Artificial insemination	Dr S.S. Prabhu, B.Sc., Ph.D. (Edin.)
Assistant Research Officers :	
Training	Dr D.P. Mukherjee, M.Sc., Ph.D. (Agra)
Artificial insemination	Mr. Gajjan Singh, G.M.V.C., B.V.Sc.
,, ,, (Bangalore centre)	Mr. S.V. Chandiramani, B.Sc. (Agri.), M.S. (Texas)
Genetics	*Vacant*
Hormone	*Vacant*
Research Assistants	Mr. M.P. Johari, G.B.V.C.
	Mr. S.N. Luktuke, G.B.V.C.
	Mr. S.S. Jawa, L.V.P.
	Mr. K.D. Bhaya, G.B.V.C.
	Mr. U.D. Sharma, B.V.Sc.
	Mr. S.N. Chatterji, G.V.Sc.
	Mr. Chet Ram, B.A., L.V.P.
	Mr. S.K. De, G.V.Sc.
	K.K. Pal, M.Sc.
Farm Superintendents :	
Breeding	Mr. A.N. Gautam, I.D.D.
Dairy	*Vacant*

Service Sections

Estate Section :	
Estate Managers :	
Mukteswar	Mr. D.K. Makhijani, B.Ag.
Izatnagar	Mr. J.D. Adwani, B.Ag.
Farm Superintendents :	
Mukteswar	Mr. S. Shillong
Izatnagar	Mr. L.R. Sah.
Veterinary Section :	
Veterinary Officers :	
Mukteswar	Mr. M.K. Sreenivasan, G.M.V.C.
Izatnagar	Mr. Tufail Ahmed, G.C.V.C.
Research Assistants :	
Mukteswar	Mr. M.S. Menon, I.D.D., G.V.Sc.
	Mr. B.K. Kathuria, G.B.V.C.
	Mr. R.N. Seth, L.V.P.
Izatnagar	Mr. S.T. Lachiramani, G.B.V.C.
Engineering Section :	
Engineer :	
Mukteswar	Mr. S.R. Nanda

Assistant Engineer :	
Izatnagar	Mr. S.R. Ganguly
Medical Section :	
Medical Officers :	
Mukteswar	Dr K.C. Pant, M.B., B.S.
Izatnagar (part-time)	Dr W.D. Wadhwani, L.S.M.F.

Office

Administrative Officer : Mr. B.R. Ramchandani, B.A.

Assistant Administrative Officers :	
Mukteswar	Mr. P.C. Atkinson
Izatnagar	Mr. H.B. Pandey
Head Clerks :	
Mukteswar	Mr. P.S. Negi
Izatnagar	Mr. S.R. Saxena
Accountants :	
Mukteswar	Mr. K.D. Pande
Izatnagar	Mr. Rama Shankar
Cashiers :	
Mukteswar	Mr. L.D. Pant
Izatnagar	Mr. H.D. Pant
Storekeepers :	
Mukteswar	Mr. B.D. Sah
Izatnagar	Mr. L.D. Pande
Stenographers	Mr. J.C. Naithani Mr. Edward March
Upper Division Clerks	*Seven posts*
Lower Division Clerks	*Thirty-eight posts*
Artist	Mr. A. Mukherji
Librarian	Mr. P.N. John

600 008.
125301

KZ: f2,m90